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MEDICAL QUACKS AND QUACKERIES.

By FRANCIS J. SHEPHERD, M. D.

JOHNSON defines a quack as "a boastful pretender to an art he does not understand," and perhaps the term is more often applied to boastful pretenders of the art of medicine than of any other.* Probably, ever since man acquired the faculty of articulate language, quacks and quackeries have flourished. In the ruder ages, man attributed all disease to the influence of evil spirits, and sought by various means to ward off or lessen their injurious and malevolent actions. Now, as an eminent physiologist has lately said, the controlling of unknown powers has always been a matter of some difficulty, and one which ordinary mortals with average ability could not successfully attempt; hence arose a class of specialists—men who, by their greater knowledge and cleverness, made others believe that they were able to cope with the unseen. These were the priests, and, without doubt, the first quacks. They supplied charms and potions, and made use of incantations, not only to cure, but to prevent disease. These services obtained for them great power and influence and increased wealth. The ancient Egyptians attributed all diseases to the anger of the gods. They worshiped Serapis as a medical divinity, and the cure of disease could only be accomplished through the intercession of this deity's priests. Thus the priests had the monopoly of medical practice, and their medical knowledge was jealously concealed from the vulgar; it was only divulged to those who with extravagant ceremonies, wonderful mummeries, and terrible vows of secrecy, were initiated into the Egyptian mysteries. It was thus that Pythagoras is supposed to have obtained the foundation of his medical knowledge and philosophy. Among the Israelites

* "'Quack' is said to be an abbreviated form of 'quacksalver,' which is derived from the Dutch *Kwabzalver*—from *Kwab*, a *wen*, and *Zalver*, an *ointment*."—*Notes and Queries.*

the priests had charge of the health of the people, and in time of plague and pestilence relied wholly on religious methods of cure. According to the accounts that have come down to us, these methods were most successful. In highly civilized Greece, priests, the direct descendants of Æsculapius, cured disease by mysterious ceremonies, music, offerings, fastings, and such like. In Rome, when a plague broke out, the priests endeavored to combat it by feasting the gods, or driving nails into the right wall of the Temple of Jupiter. The early Christian Church was strongly opposed to the progress of medicine. It believed that the power of curing disease had been transmitted from Christ and his apostles to their bishops and elders. They discarded altogether the use of medicinal agents, and healed the sick by prayer, the laying on of hands, and the anointing with oil. This form of treatment, being of the miraculous order, needed no knowledge of the nature of disease, or of the structure of the human frame. Heathen priests and physicians were regarded as sorcerers and dealers in witchcraft, and so were burned or otherwise put out of the way. For some centuries the monks monopolized all the medical practice and quackery. They made a good living, selling for large sums of money remnants of ancient martyrs, waters of holy wells, portions of the true cross, etc., as a protection against sickness, witchcraft, evil spirits, and other ills that flesh was heir to in those dark ages. They prayed to St. Anthony for inflammation, St. Valentine for epilepsy, St. Clara for sore eyes, St. Appolonia for toothache, St. Vitus for madness and poison, and so on.* It was not till after the breaking up of the powers of the priesthood by the Reformation, and the introduction of printing, that medicine began to escape from the grasp of quackery and made rapid strides toward the truth, perfecting knowledge of disease by accurate observation and the study of the human frame and its workings in health. That the emancipation of medicine from superstition did not immediately take place is evidenced by the wonderful hold the belief in the cure of scrofula by the royal touch had on the people, both medical and lay, for many years after the Reformation, nay, almost down to our own time. This most remarkable form of quackery, and one, according to

* The Medical Rose offers a peculiar and very approved remedy for epilepsy. Advising the patient to stand upright, saying the Lord's prayer with the mouth wide open to prevent the first attack, and informing us that a lunatic, an epileptic, and a demoniac were the same, he gives the following sacrophysical directions: "When the patient and his parents have fasted three days, let them conduct him to a church. If he be of a proper age and in his right senses, let him confess. Then let him hear mass on Friday, during the fast of *quatuor temporum*, and also on Saturday. On Sunday let a good and religious priest read over his head in church the gospel which is read in September in the time of vintage, after the feast of the Holy Cross. After this, let the same priest write the same gospel devoutly, and let the patient wear it about his neck, and he shall be cured. The gospel is, 'This kind goeth not out but by prayer and fasting.' "—("Rosa Anglica," p. 78, edition 1491; ib., p. 415, edition 1595—quoted in Willcock's "Laws of the Medical Profession," p. 25, edition 1830.)

some, peculiarly English in its origin, was exercised in England for nearly seven hundred years. Edward the Confessor was the first who touched for the king's-evil, and transmitted the gift to all his successors. His power was attributed not to his royalty but to his sanctity, and there "seemed little reason why his successors, who were, as a rule, no saints, should be so specially favored." The kings of France also claimed the right to dispense the gift of healing, and traced their right to Clovis. Queen Anne was the last to exercise this gift in England, and it is well known that she touched, among others, the celebrated Dr. Johnson, who was brought to the King by his mother on the recommendation of Sir John Floyer, a distinguished physician of Litchfield.* William III had too much sense to pander to the superstitious feelings of many of his subjects, and never employed the touch but once, and then he said, on laying his hands on the patient, "May God give you better health and more sense!" Queen Elizabeth was averse to the practice, but extensively performed it. Charles II excelled all his predecessors and successors in this ceremony. During his reign he touched nearly one hundred thousand persons for the evil. One year (1682) over eight thousand sufferers were subjected to his sacred touch. The patients were first examined by the King's surgeons, and, if thought to be fitting objects of relief, they were given tickets to admit them to the royal presence. When admitted, the patient knelt and was touched by the King. The clerk of the closet now handed his Majesty a gold coin, to which was attached a piece of white ribbon, and, while the King hung this round the neck of the patient, others read the prayers and ceremonies specially appointed for this purpose. We are told that the gold was a token of good-will, and not necessary to the cure, as many were healed without it, or with silver employed instead. Evidences of the efficacy of the royal touch are not wanting: Jeremy Collier says of Edward the Confessor: "That this prince cured king's-evil is beyond dispute, and, since the credit of this miracle is unquestionable, I see no reason why we should not believe the rest." John Browne, surgeon to Charles II, and a man of eminence and reputation in his profession, wrote an "Anatomick-Chirurgical Treatise on Glandules and Strumæ, together with the Royal Gift of Healing or Cure thereof by Contact or Imposition of Hands," etc. In this treatise he gives "many wonderful examples of cures by the sacred touch" of Charles II; he also relates several cases of scrofulous tumor and sore cured by being touched with handkerchiefs which had been dipped in the blood of the martyr Charles I, and asserts that the usurper Cromwell tried in vain to exercise this royal prerogative, "he having no more right to the healing power than he had to regal jurisdiction." Wiseman, in his work on surgery, which was the best book on the subject

* The gold coin presented to Dr. Johnson by the Queen is at the present time in the British Museum.

at that time, says: "I myself have been a frequent eye-witness of many hundred cures performed by his Majesty's touch alone, without any assistance of chirurgery"; still it does not appear that he sent his patients to the King, and he gives his own method of curing scrofula with great minuteness. This evidence as to the cures is apparently most complete, and is that of men skilled in the medical art who were eye-witnesses and assisted in the ceremonies. Of course now no one believes that there was virtue in the royal touch any more than that the philosopher's stone could convert baser metals into gold. If the King could cure scrofula, how is it that during Charles II's reign scrofula was more prevalent than for many years previously? No doubt it was because people neglected ordinary methods of treatment, in their desire to be cured miraculously.

The only way it is possible to explain the evidence of Browne and Wiseman is that they were ardent royalists, and held the efficacy of the royal touch to be as much a party tenet as the divine right of kings, and that by doing so they pleased the court and so advanced their own interests. Had they doubted it, they would have incurred the suspicion of being disaffected to the government.* Failures of cure were attributed, as in our own day, to want of faith, as one writer puts it, "none ever failed of receiving benefit unless their little faith and credulity starved their merits."

Curing diseases by the laying on of hands was practiced with great success by Valentine Greatraikes, an Irish gentleman of good family, who served under Cromwell both in a military and civil capacity. At the Restoration, being deprived of his offices, he undertook to cure the king's-evil by touch, or stroking, as it was called; he succeeded so well in this that he extended the field of his labors and treated epilepsy, asthma, convulsions, deafness, etc., by the same method. The latter diseases being all due to disorders of the nervous system, benefit was no doubt frequently obtained through the effect of the imagination. "Imagination," says Lord Bacon, "is next akin to a miracle-working faith." Greatraikes's fame soon spread, and he was sent for from far and near; the Earl of Orrery and Lord Conway patronized him, and he even deceived the great Robert Boyle. At length he arrived in London, where for some time he was most popular. The majority of his admirers were ladies, and on the more hysterical of the sex he performed marvelous cures. Soon, however, the tongues of slander and ridicule assailed him, and he retired to his native country and obscurity. Many others succeeded Greatraikes. John Everett, or Leverett, the seventh son of a seventh son, and a gardener, practiced

* One Thomas Rosewell was actually tried for high treason in 1684 for saying that "people made a flocking to the King, upon pretense of being healed of the king's-evil, which he could not do, but that they, being priests and prophets, could by their prayers do as much." Rosewell was tried by the celebrated Judge Jeffries and found guilty, but afterward pardoned.—(Wadd's "Mems and Maxims," p. 136.)

the "manual exercise," and declared that after touching thirty to forty a day he felt the goodness go out of him. No doubt these people practiced unconsciously what Mesmer many years after practiced by design. On the subject of Mesmerism and spiritualism I do not propose to enter. Of late years cures by the laying on of hands, assisted, however, by prayer, and the anointing with oil, have become very common, especially in the United States, the hot-bed of all sorts of quackeries. This summer there has been a "faith convention" at Old Orchard, in Maine, where many people were publicly cured by this method; all the diseases treated appeared to be, from the indefinite history of cases reported in religious newspapers, affections of the nervous system. Many hysterical cases were possibly benefited purely by the effect of the imagination: as the disases are ones of the imagination, so are the cures. We have yet to hear of a case of actual disease, such as is daily seen in our hospitals, cured by this method.

The immediate progenitor of our present race of quacks is Paracelsus, who flourished in the sixteenth century; he generally styled himself Philippus Aureolus Theophrastus Paracelsus Bombastus von Hohenheim. His father, who was the natural son of a prince, gave him an excellent education. He studied medicine, and afterward was for some time professor at Basle, in Switzerland. Paracelsus denied the utility of knowing the cause or mode of origin of disease; he said all he wanted to know was, how to cure it. He styled himself the monarch of physicians, and asserted that the hair on the back of his head knew more than all the writers from Galen to Avicenna, and he publicly burned their books. He invented a nostrum called "azoth," which he vaunted as the philosopher's stone, the tincture of life. He proclaimed that he had the power of making man immortal, yet he died at the age of forty-eight. Still, by the aid of opium, antimony, and mercury, he performed some wonderful cures, and to him must be awarded the credit of first drawing the attention of the profession to the value of these remedies in the treatment of diseases. He also helped medicine to advance by showing contempt for traditional methods of treatment and the humoral pathology of the ancients, which had held sway for over two thousand years.

The most remarkable example of credulity and superstition of the public is found in the history of two quackeries which flourished in the sixteenth and seventeenth centuries. I refer to the *weapon-ointment* and *sympathetic-powder* cures. The weapon-ointment was used in healing wounds; but, instead of the ointment being applied to the wound, it was applied to the weapon which caused it. This was fortunate for the people so treated, as the applications to fresh wounds in those times were most barbarous. The ointment was prepared in various ways, and its ingredients were most diverse, consisting of human fat and blood, mummy, moss from a dead man's skull, bull's blood and fat, etc. At one time there was a schism in the weapon-salve school, and a

serious and acrimonious discussion arose as to "whether it was necessary that the moss should grow absolutely on the skull of a thief who had hung on the gallows, and whether the ointment, while compounding, was to be stirred with a murderer's knife." The mode of application was this: The wound was first washed, bandaged, and ordered to be kept at rest, and then the offending weapon was anointed with the salve, carefully wrapped up, and placed in a safe position. If the weapon was left undisturbed the wound healed in a few days, but, if anything happened to the anointed weapon the wound would break out afresh. In Dryden's version of Shakespeare's "Tempest," he makes Ariel say, in reference to the wound received by Hippolito from Ferdinand:

> "He must be dressed again, as I have done it:
> Anoint the sword which pierced him with this weapon-salve;
> Wrap it close from air, till I have time to visit him again."

In Glapthorne's comedy, "The Hollander," the doctor says, "The same salve will cure at any distance, as if a person hurt should be at York, the weapon dressed at London, on which the blood is." That the belief in this salve was not universal is proved by an attack made on it by John Hales, of Eton, in a letter "to an honorable person" in 1630. He declares it is a child of but yesterday's birth, one among the pleasant fantasies of the Rosicrucians; and, as for the cures it has worked, "the effect is wrought by one thing, and another carries off the glory," etc.*

The *sympathetic powder* was much the same kind of remedy, and was introduced into England by Sir Kenelm Digby, a gentleman of the bedchamber of Charles I. It is said that a Carmelite friar, returning from the East, brought the recipe for this powder with him. Sir Kenelm did him some service, and was rewarded by obtaining the secret of the sympathetic powder. It consisted merely of blue vitriol prepared with mysterious ceremonies. Digby revealed the secret to James I, who disclosed it to Dr. Mayerne, his physician. The latter sold it to many distinguished persons, and then it soon ceased to be a secret. A solution of the powder was made, and some of the wounded man's blood-stained garments immersed in it, the wound at the same time being washed and bandaged, and strict abstinence being enjoined on the patient. As may be inferred, the sympathetic powder, like the weapon-salve, was quite as efficacious at a distance as near by. These remedies did one good: they taught people how soon wounds heal if kept clean and undisturbed, and, in fact, opened the way to our present method of treating wounds. Surgeons learned that, in their healing, Nature was a powerful factor, and must be aided, not interfered with.†

* Chambers's "Book of Days," vol. ii.

† A somewhat similar superstition exists in many parts of the country to this day. I well remember, when a child, that, having my hands full of warts, they were rubbed by my nurse with a piece of raw meat; the meat was then placed under a stone, and I was told (and this was generally believed) that as the meat decayed the warts would disap-

It would be impossible for me to describe a tenth part of the quacks who flourished in England during the eighteenth century. There was Joanna Stevens, to whom Parliament voted £5,000 in 1739, for disclosing the secret of her remedy for dissolving stone. The wonderful secret remedy consisted chiefly of powdered snail- and egg-shells, and, notwithstanding its disclosure, "there have been as many human calculi since formed by his Majesty's liege lithotomical subjects as would macadamize one side of Lincoln's Inn Fields," says Wadd. David Hartley, the philosopher, was a great supporter of Joanna Stevens, and, after eating two hundred pounds' weight of her remedy, he himself died of the stone. There was Sir William Read, originally a tailor and cobbler, and afterward a quack oculist, knighted by Queen Anne, and who not only had the care of her eyes, but also treated George I. There was the clever but vain Hill, who quacked a gout specific called "tincture of bandana," and of whom Garrick has happily said:

"For physic and farces his equal there scarce is—
His farce is a physic, his physic a farce is."

He commenced life as an apothecary, and ended by making a considerable figure in the fashionable world and marrying the sister of Lord Ranelagh.

Three of the most notorious quacks who imposed on the credulity of the public during the middle of the eighteenth century attained sufficient fame to be made the subject of a satirical picture by Hogarth. The picture was called "The Undertaker's Arms," with the motto "*Et plurima mortis imago*," and the most prominent figures in it were—first, Chevalier Taylor, a quack oculist of unparalleled effrontery, who wrote a most marvelous biography of himself, which at one time had a great sale; second, Joshua Ward, originally a footman, who invented a pill and drop; he was called in to see the King, who, in spite of the remedies administered, recovered—Ward for his services received a vote of thanks from the House of Commons, and got leave to drive his carriage through St. James's Park; and, third, last but not least, the celebrated Mrs. Mapp, the Amazonian bone-setter of Epsom, who surpassed all her rivals in quackery, and whose strength of arm was only equaled by her strength of language. She was the daughter of Wallis, a bone-setter, and sister of "Polly Peachem," who married the Duke of Bolton. She drove about London in a coach-and-six with outriders, and the most exalted in rank and station eagerly sought the company of this drunken female savage. She succeeded Taylor and Ward, and is sung of as follows by some Grub Street poet:

"In physic as well as in fashion we find
The newest has always the run with mankind;
Forgot in the bustle 'bout Taylor and Ward,
Now Mapp's all the cry, and her fame on record.

pear. The result of the experiment I can not remember, but I imagine the warts remained for some time after the decay of the meat.

So what signifies learning, or going to school,
When woman can do without reason or rule?"

England in the eighteenth century has been truly named the "Paradise of Quacks." Our ancestors were assuredly a nostrum-loving lot, from the King to the peasant. Truly they must have thought with the prophet, "The Lord hath created medicines out of the earth; and he that is wise will not abhor them" (Ecclesiasticus xxxviii, 4). Perhaps the most remarkable of unblushing quacks who flourished toward the end of the eighteenth century was Dr. Graham, a graduate of Edinburgh, and a fellow-student of Sir James Mackintosh. He introduced Mesmerism into England, and was nearly as successful as his master. In 1780 he went to London and occupied a magnificent mansion, which he designated the "Temple of Health and Hymen." It was gorgeously furnished, and a fortune was spent on the decorations. The spacious rooms were adorned with marble statues, stands of armor, plates of burnished steel, and superbly lighted with wax-candles; sweet strains of distant music were continually floating through the air, and delicious perfumes were always burning in swinging censers; at the door were stationed two gigantic porters, clad in showy liveries covered with gold lace. In this "Enchanting Elysian Palace" Dr. Graham delivered his lectures on health and procreation at two guineas a head, and he did not want for hearers. In his *séances* he was assisted by a beautiful woman, whom he called Vestina, the rosy goddess of health—she who afterward became Lady Hamilton, the favorite of Nelson. In the daytime he was assisted in his electrical experiments by Dr. Mitford, the father of the celebrated authoress. In this temple was a celestial bed standing on glass legs and ornamented with the richest hangings; he pretended that childless married pairs who slept in this bed would be certain to have heirs. The price was £100 a night, and many persons of high rank eagerly accepted the terms. He then advertised an elixir of life, which, it is said, he sold to more than one noble simpleton for £1,000. One mode of treatment he recommended for prolonging life was the frequent use of mud-baths. Soon, from his religious extravagances, Graham became unpopular, and, retiring from public life, he died poor in the neighborhood of Glasgow.

A species of quackery called "Perkinism," which made a stir in the world in the beginning of the present century, I must now shortly describe, for, among the delusions which have succeeded in imposing on men of education and position, it is pre-eminent. It orignated in America, and to Dr. Oliver Wendell Holmes I am indebted for most of my information on the subject. Dr. Elisha Perkins was born in Connecticut, in 1740; he practiced with success for many years, but, being inspired by the recent discoveries of Galvani, he conceived the idea that metallic substances applied in a certain manner might remove disease. In 1796 he gave to the world his metallic "Tractors." These consisted "of two pieces of metal, one iron and one brass, about three

inches long, blunt at one end and pointed at the other." They (so he affirmed) "cured rheumatism, local pains, inflammation, and even tumors, by drawing them over the affected parts for a few minutes." Dr. Perkins patented his discovery, and soon found numerous adherents, many of them being men of wealth and position. His son, Benjamin Douglass Perkins, crossed the Atlantic with the tractors, and in 1798 they were employed in the Royal Hospital in Copenhagen. In London their reputation was quickly established, and they soon became the fashion. The Royal Society accepted Perkins's tractors and book, and passed a vote of thanks to him; by 1804 a "Perkinean Institution" had been founded, which published transactions and held annual dinners. Lord Rivers was the first president, Governor Franklin vice-president, and Lord Henneker, a fellow of the Royal Society, one of the members. All this time Douglass Perkins was coining money by selling tractors at five guineas each, which cost about ninepence. A hospital was built, where the only treatment was "tractoration." Persons in the highest positions willingly gave testimonials, telling of the marvelous cures wrought on themselves and their friends by these wonderful tractors. The bishops and clergymen on both sides of the Atlantic were most eager to thrust forward evidence on this medical topic; whole pages of panegyric were contributed by them. One writes, "I have used the tractors with success in several other cases in my own family, and, although like Naaman, the Syrian, I can not tell why the waters of Jordan should be better than Abana and Pharpar, rivers of Damascus, yet since experience has proved them so no reasoning can change the opinion" ("Currents and Counter-Currents," p. 85).

Many ministers of religion were furnished with tractors gratuitously, and Dr. Holmes remarks that one of the risks of infancy he had to encounter was Perkins's tractors. The medical profession was ever hostile to the new revelation, and their hostility by many was attributed to jealousy and self-interest. The Connecticut Medical Society, in 1797, expelled Dr. Perkins, for violating their regulations against nostrums and secret remedies. The bubble was burst by Dr. Haygarth, of Bath, who experimented on patients with bogus tractors made of wood: he was quite as successful with them as with the five-guinea ones! These experiments did not immediately destroy the belief of the real Perkinistic enthusiasts, because, as Froude says, "belief in the marvelous does not rise from evidence, and will not yield to it." After a time, however, Perkinism passed away so quietly that the date of its death is unrecorded. Lord Byron, in his "English Bards and Scotch Reviewers," refers to these celebrated Tractors:*

* "Thus saith the Preacher, 'Naught beneath the sun
Is new,' yet still from change to change we run;
What varied wonders tempt us as they pass!—
The cow-pox, *Tractors*, galvanism, gas,
In turns appear to make the vulgar stare,
Till the swoll'n bubble bursts—and all is air!"

Within the last few years, a form of Perkinism, or rather "metallic medicine," has appeared in Paris, clothed in the garb of science, and under the protecting influence of the great M. Charcot. Gold, silver, and other metals, in the form of coins, are applied to relieve the manifestations of the graver forms of hysteria. It has become quite the 'mode' to visit the Hôpital de la Salpêtrière, and witness the sensational cures performed publicly on the victims of hystero-epilepsy. This notoriety is both pleasing to the patients and the public. If a nervous disease is treated by unusual methods, it becomes common; hysterical subjects having always a morbid desire to make themselves remarkable, and so be the center of attraction, it pleases their vanity and self-love. The consequence of the introduction of metallo-therapy into Parisian hospitals as a mode of treatment is, that in Paris and its neighborhood an enormous number of these rarer forms of hysteria and hystero-epilepsy have been, so to speak, created, and the wards of some of the hospitals there are crowded with female patients, eager to be treated in a sensational and novel manner. They certainly derive benefit from the treatment, because, as a writer in the "Lancet" has said: "The symptoms for which metals are applied can not be ascertained without calling the patient's attention to their existence; the strange and unusual remedy of application of a string of coins can not be adopted without exciting expectation of a local result—an expectation which it has been often demonstrated is sufficient to determine the disappearance of local symptoms in this remarkable disease."

My paper would be very incomplete should I fail to mention the most successful quack this century has produced, John St. John Long. He was the son of an Irish basket-maker, and was born near Doneraile. In his boyhood he assisted his father, but, soon tiring of rush-weaving, being a clever, pushing youth, he attached himself to a Dublin portrait-painter, from whom he obtained some knowledge of painting. When next we hear of him he is starring the provinces as an historical and portrait painter, and an instructor in the art of painting in oils. It was at this time that he adopted the name St. John. With the Limerick gentry he was a great favorite, because of his entertaining manners, and his ability to ride straight across country. Becoming disgusted with provincial life, and feeling that his talents could be more profitably employed in a larger sphere, he went to London. Here, by his pleasant address and persuasive tongue, he managed to get introductions into several respectable houses, and was elected a member of the Royal Society of Literature and of the Royal Asiatic Society. But he could not live on these honors, and was glad to color anatomical drawings for the lecturers and students at the various schools of anatomy. In this way he learned something about the human frame, and before many months had passed he proclaimed to the world the discovery of a wonderful liniment, which, when applied

to a healthy part, was as harmless as water, but when applied to a surface covering a diseased organ caused the morbific humor to exude. His success was immediate and great. Patients from London and all parts of the country rushed to consult the miracle-worker in his house in Harley Street. Ladies of the highest rank hastened to place themselves and their ailing daughters under his care. Long was shrewd enough not to undertake the cure of cases which were apparently hopeless. He pretended to cure consumption by the application of his liniment, and of course, as nine out of ten of his patients were women, and a large majority of these hysterical or perfectly healthy, his success was marvelous. For several years his income exceeded £13,000. He went out into fashionable society, and was a lion in the most aristocratic circles; his ready wit, fascinating manners, intellectual countenance, and handsome figure, procured him a host of admirers, among whom were Lord Ingestre, the Marquis of Sligo, Lady Harriet Kavanah, the Marchioness of Ormond, the Countess of Buckinghamshire, and many others. Long was a superb horseman, hunted regularly, and rode magnificent animals. "On one occasion, as he was cantering round the park, he saw a man strike a woman, and, without an instant's hesitation, he pulled up, leaped from his horse, seized the fellow bodily, and flung him over the park-rails." He had many offers of marriage, but declined them all. He wrote a book called "Discoveries in the Science and Art of Healing," which was well padded with letters from grateful patients, and testimonials of miraculous cures from his aristocratic friends. Soon misfortune came upon him; his liniment was applied to the back and breast of a perfectly healthy girl, inflammation set in, followed by gangrene, and in a few days his patient was no more. Long was convicted of manslaughter, and fined only £200 by a partial judge. In his trial he was supported and petted by his lady admirers, who gave evidence in his favor. One nobleman swore that Long had abstracted pure quicksilver from his head. Soon another patient fell a victim to his treatment; he was again tried for manslaughter, and again had the sympathy of his female friends, but this time he was acquitted. These trials had no effect in lessening his popularity: he went about proclaiming himself a martyr, comparing his case to that of Galileo, Harvey, and others. He died while still young, in 1834, retaining a large practice to the last. His admirers raised a magnificent monument to his memory in Kensal Green Cemetery, adorned with a long and laudatory inscription. After his death, his property became the subject of very tedious litigation. Among the claimants was a woman of humble station in life, who proved to be his wife. This explained his preference for bachelorhood. The wonderful liniment turned out to be *acetic acid*, which looks much like water. He of course substituted a bottle of water when he did not wish the "morbific humor" to come out, and so gulled his willing victims.

George Eliot, in "Middlemarch," alludes to St. John Long and his quackeries.

Homœopathy is another form of quackery to which I must shortly allude. It originated in 1796, with Hahnemann, a German physician. Hahnemann laid down, as necessary to his system, three great foundation truths:

1. *Similia similibus curantur.* This means that diseases are to be cured by the administration of substances which, in healthy individuals, produce the same symptoms or group of symptoms as the disease itself manifests. This idea was not original with Hahnemann. Hippocrates distinctly enunciates it, and since then it has been held by many physicians and others, including Paracelsus, who was the inspirer of Hahnemann.

2. That it is necessary to give remedies in infinitesimal doses. Substances which are given by the regular school in doses of four to five grains, homœopaths should give in quantities of two decillionths of a grain and less. Hahnemann says, in his "Organon": "But, if the patient is very sensitive, it will be sufficient to let him smell once of a vial containing a globule of sugar the size of a mustard-seed; after the patient has smelled it, the vial is to be recorked, and will thus serve for years without its medical virtues being perceptibly impaired." This second "great truth" was, as has been lately pointed out by Dr. Holmes, adopted from Van Helmont, a physician who flourished in the early part of the seventeenth century. He denied the existence of the four elements, and held up to ridicule the practice of letting blood for the cure of disease.

Van Helmont, in his "Ortus Medicinæ," describes a method of treatment made use of by one Butler, an Irishman, who was formerly physician to James I, and at that time was confined in prison in Belgium. According to Van Helmont, Butler performed wonderful cures with a pebble he had in his possession. He dipped this pebble quickly into a teaspoonful of olive-oil, poured this "magnetized oil" into a large vessel of oil, and directed the patient to take one drop occasionally. When one drop was put on the head of an old woman suffering from hemicrania, the pain instantly disappeared. An abbess was relieved of loss of power in her right arm by merely touching her tongue to the pebble. No doubt reading this book first suggested infinitesimal doses to Hahnemann.

Hahnemann's "third dogma or truth" was, that seven eighths of all chronic diseases are produced by psora, or itch. "This psora," says Hahnemann, "is the sole, true, and fundamental cause that produces all the other countless forms of disease, which go under the names of hysteria, hypochondriasis, debility, insanity, melancholy, idiocy, epilepsy, cancer, gout, paralysis," etc., etc. (I shall not complete the list). He tells the reader in a foot-note that it took him twelve years to trace out the source of all these diseases. This third dogma was original

with Hahnemann, and no one now wishes to detract from the laurels he may have won by thus simplifying the etiology of diseases which hitherto have been so obscure in their origin.

Unfortunately for his theory, since the discovery of the *sarcoptis hominis*, or itch-insect, the dogma about the psora being such a powerful factor in the causation of disease has fallen to the ground, and homœopaths are not fond of referring to it. Like Paracelsus, Hahnemann paid no attention to the pathology * or cause of disease, but only sought for symptoms. For instance, in a case of dropsy, the cause, whether it be from the heart, the kidneys, or the liver, is not inquired into, but the symptom dropsy is treated. Dr. Black, in his "Practice of Homœopathy," tells us: "If the cause of the disease be an inflammation of the brain, a remedy has to be chosen which produces this pathological condition; and, if the exciting cause can be traced to the abuse of alcoholic liquors, a remedy should be selected which is nearest akin to alcohol in its action." This is what is called "a proving."

The dilutions are directed to be prepared by Hahnemann with as much mystery and jugglery as the "sympathetic powder." The following directions are taken from Hahnemann's "Organon": "A grain of the substance, if it is solid, and a drop, if liquid, is to be added to about a third part of 100 grains of sugar of milk in an unglazed porcelain capsule, which has had the polish removed from the lower part of its cavity by rubbing with wet sand; they are to be mingled for an instant with a bone or horn spatula, and then rubbed together for six minutes; then the mass is to be scraped together from the mortar and pestle, which is to take four minutes, then to be again rubbed for six minutes with equal force. Four minutes are then to be devoted to scraping the powder into a heap, and the second third of the 100 grains of sugar of milk to be added. Then they are to be stirred an instant and rubbed six minutes, again to be scraped together for four, and forcibly rubbed for six, once more scraped together for four minutes and rubbed down for six. Then the last third of the 100 grains of sugar of milk is to be added and mingled by stirring with a spatula. Six minutes of forcible rubbing, four of scraping together, six more of rubbing, finish the process. Now to one grain of the powder so manufactured is to be added a third part of 100 grains of sugar of milk, and the whole mixed in a mortar, and having triturated each third portion for six minutes, and scraped for four minutes, the whole powder is placed in a corked bottle and marked with its degree of attenuation, which will be the $\frac{1}{10000}$ or second dilution. The same method is observed for this powder as was detailed for the last for making any attenuation up to a decillionth and quintillionth."

* A new school, which has arisen within the last few years, also pays no attention to pathology. The members of this school do not wait for symptoms even, but endeavor to "jugulate" the disease at once. They call themselves the "Dosimetric School," because they treat disease by granules containing alkaloids and metallic salts in fixed doses.

The method for making fluid dilutions is the same, but instead of sugar of milk alcohol is used. The scrapings and triturations are exchanged for shakes of the bottle in certain directions. Toward the close of his life Hahnemann reduced the number of his shakes. He says, "A long experience and multiplied observations upon the sick lead me within the last few years to prefer giving only two shakes to medicinal liquids, whereas I formerly used to give ten."

Now to give one an idea of the potency of these drugs: to obtain a grain of the original substance in the third attenuation, one would have to swallow four hundred-weight of sugar; or, to get a drop of the original tincture, a barrel of alcohol would have to be imbibed. Now, this is only the third dilution. In the eighth dilution, to obtain a drop of the tincture the whole Atlantic Ocean full of alcohol would be necessary. Dr. Black, to whom I have referred, says he uses the first, third, sixth, ninth, up to the thirtieth dilution. Imagine the effect of one-drop doses of the thirtieth dilution! The finite mind can not comprehend the infinitesimal when thus expressed.

Homœopathy, although not yet deceased, retains hardly anything of its original character but the name. The efficacy of infinitesimal doses is doubted by the leaders of the school, and even the doctrine of *similia similibus curantur* is not now considered universal. Dr. George Wild, Vice-President of the British Homœopathic Society, in a letter to the London "Lancet," June, 1877, says that he believes "palpable doses of medicine are generally more efficacious in the treatment of disease than infinitesimal ones." Also, that "some diseases are best treated by similars and some by contraries."

The third dogma, with regard to the psora, or itch, has been, since the discovery of the itch-insect, effectually disposed of forever. As Dr. Holmes remarks, "What there is left of the three-legged stool after one of its legs is pulled out, and the other two sawed half or three quarters through, seems hardly worth sitting down on."

The name homœopathy has a charm for the public, and so is retained to juggle with. When, in 1833, the edition of the "Organon" from which I have quoted was published, the translator, in the preface, mentioned that this new system of medicine was spreading through the Continent of Europe with the rapidity of lightning. In 1880, in an address read before the Institute of Homœopathy, in Milwaukee—"How can we best advance Homœopathy?"—the author says: "It can not be denied that homœopathy has not advanced, and is not advancing, as rapidly as we once had just and reasonable grounds for expecting. In Great Britain there are but two hundred and seventy-five homœopathic physicians, and in the United States there is not one legally recognized school of homœopathy." He concludes by saying that there seems to be everywhere stagnation, if not retrogression. Dr. Smyth, in his book on "Medical Heresies," mentions that a short time since the County Hospital, Sacramento, was in

charge of homœopathic physicians; quite recently they have been relieved from further attendance by the managers, because of the extravagant expenditure of money for drugs. Among the items are three pounds of salicylic acid and four thousand grains of quinine.

In Ontario, up to ten years ago, homœopaths were yearly registered by scores; since then they have to pass through the same courses and examinations as the regular students, in all but therapeutics and pharmacy. The consequence is, that in ten years there have only been two or three applications for examinations as homœopaths. Homœopathy, being a system utterly devoid of any scientific foundation, is now dying a natural death.

It is difficult to give the exact reason or reasons why quackery is so prevalent. The causes are very various and obscure. Southey says: "Man is a dupable animal; quacks in medicine, quacks in religion, and quacks in politics know this, and act upon that knowledge. There is scarcely any one who may not, like a trout, be taken by tickling." It is extraordinary what a hold the mystic and marvelous still have on many people; there seems to be in almost every one a vein of credulity and superstition against which argument is useless. The disposition to be humbugged preponderates in human nature over reason and common sense. Education, at least the education of the day, apparently has no influence in depriving people of this quality. Men of education are the very ones who have been, and are now, duped by clever quacks. A man may be an able politician, distinguished in literature, of great shrewdness in the ordinary business of life, and yet believe in spiritualism, homœopathy, Perkinism, and tar-water. When he is ill he will probably, after taking in vain the various much vaunted and advertised panaceas, call in some quack who promises a cure in a certain time and in some uncommon manner.

Bishop Berkeley is an example of a man of great attainments, whose mind was obscured by quackery. His tar-water he considered an infallible remedy for all ailments, and wrote a book describing its universal efficacy in curing disease. Dr. O. W. Holmes says: "He might have lived longer, but his fatal illness was so sudden that there was no time to stir up a quart of the panacea. He was a very illustrious man, but he held two very odd opinions, that tar-water was everything, and that the whole material universe was nothing ("Currents and Counter-Currents," p. 72). Alfred Russel Wallace,* the emi-

* Mr. Wallace, in his book on "Miracles and Modern Spiritualism," holds that the theory of a future existence as taught by spiritualists is the "only one yet given to the world that can at all commend itself to the modern philosophical mind," and in the spiritual world the law of "progression of the fittest" takes the place of the grand law of the "survival of the fittest" in the material world. He also holds that witches were what are now called "mediums." Owing to the number of witches destroyed for several centuries, the production of spiritual phenomena became impossible, which accounts for spiritualism being of comparatively recent origin.

nent naturalist and evolutionist, Mr. Crooke, the celebrated physicist, and Pasteur, the scientist, are ardent spiritualists, and believe that diseases may be cured by means of spiritualism. Disraeli was a homœopathist; Sir Robert Walpole patronized a quack medicine, said to dissolve the stone; Lord Bolingbroke died from the effects of a quack cancer-remedy; and I could enumerate many more men of equal talents who were similiarly affected with this mental obliquity.

Probably the greatest supporters of quacks and quackeries, next to the fair sex, are ministers of religion; hardly an advertisement of a quack-remedy can be read without coming across testimonials from them. They are generally the first to support any new form of charlatanism. In the country parts, especially, while administering to diseased souls they love to essay the efficacies of new cure-alls on diseased bodies. This weakness may be attributed to their well-known benevolence, and desire to do good to their fellow-men.

If anybody is bold and unblushing enough to assert that he has a remedy which cures every disease, and reiterates it often and loudly enough, he is sure to have a following of believers, among whom will be found men of ability and position. Human credulity is too strong to resist the frequent and positive assertions of the quack. Persons who are not trained in scientific methods of thought, and who know nothing about physiology, even if in the every-day affairs of life they are most clear-headed, are perfectly incompetent to form just opinions on medical matters.

The arguments in favor of the different forms of quackery are always the same. They say, "I was ill, I took a certain remedy or went through a certain form of treatment, and got well." This argument is irresistible, and "therefore quackery is immortal." Now, nine out of ten, nay, I venture to say nineteen out of twenty people, suffering from the ordinary acute diseases, if left to nature, get well. In every case of illness a quack administers remedies, and, of course, if the patient recovers, his recovery is attributed to the remedy; consequently the proportion of cures is large, and the number grows in the telling. In olden times, when diseases were treated by charms, fastings, prayers, and ceremonies, many of the physicians and priests, not understanding the power of nature, thought themselves favored with supernatural assistance. The quack of to-day, however, thoroughly understands what an able partner Dr. Nature is. If you ask a believer in some form of quackery the *modus operandi* of the drug or application, he tells you that there are many mysteries in nature which it is impossible to understand. If you attribute the effect to imagination, he answers that the remedy is quite as efficacious administered to young children and brute beasts, but, as Dr. Haygarth observes, "In these cases it is not the patient, but the observer, who is deceived by his own imagination."

Now, when any remedy has to be tested as being useful in a

certain disease, we have, first, to be sure that the disease exists; secondly, that it was cured; and, thirdly, that the remedy cured the disease.

It is very common for quacks to call carbuncles cancers, ordinary sore-throats diphtheria, and so on, and so boast of their wonderful cures, when Nature alone deserves the praise. In no country in the world are quacks more abundant than in the United States. Every city teems with faith-cure men, rubbers and strokers, clairvoyants, homœopaths, eclectics, bone-setters, cancer-doctors, etc., etc. The advertising columns of the daily and weekly press, in the smaller towns especially, are principally filled with quack advertisements, some of them of the most disgusting and disgraceful nature, and these too in perfectly respectable sheets, which find their way without question into family circles. Religious newspapers are no exceptions to the rule; in them the advertisements have a religious gloss to attract the holy. Perhaps texts are quoted, or the advertiser poses as a philanthropist or clergyman, and treats the poor *gratis;* at the same time he hints that the only reason he is so generous is that he *enjoys* the luxury of doing good to suffering humanity. Quacks have many ways of advertising. One asserts, as a scientific fact, that all diseases originate in disorders of the nervous system, and urges every one, before it is too late, to come and drink of his nervine tonic. Another states that physicians now admit that all diseases are due to impure blood, and vaunts the efficacy of his magnetic blood-purifier. Then comes a vile woodcut of the inventor, with a list of the testimonials of the most laudatory character, showing how this more than human doctor had snatched the writer from the jaws of death, and perhaps something worse; or perhaps we have a "Golden Medical Discovery," and are told that the receipt for this medicine was found in the luggage of a deceased Zulu chief, or that it had been a secret of the medicine-men among the Yucatan Indians for hundreds of years, and was providentially discovered by the advertiser. To suit patients who dislike internal remedies, artful and designing quacks have furnished liver, stomach, and kidney pads, and magnetic belts, giving illustrations at the same time to show how these should be applied. I have been told by a wholesale druggist that thousands are sold by the trade, monthly, to the credulous who are continually seeking for new medical divinities. Their action is much the same as Perkins's Tractors. That these advertisers are successful in selling their wares is shown by the enormous prices they pay for advertising, and the colossal fortunes which men like Holloway, Helmbold, Ayer, and others have made. If bread-pills were to be advertised, until they came into notice, as some wonderful vegetable compound from the center of the "Dark Continent," and that they cured all diseases, they could not fail to acquire celebrity, for, of the thousands who would take them, a certain number would be sure to get well.

Another kind of quack is one who does not charge for advice, but

when a patient consults him he terrifies him into believing he has some serious disease which only his medicine can cure. This is a very old form of quackery. Robert Pitt, in a book called "The Crafts and Frauds of Physic exposed," published in London in 1703, says, "A quack is a practitioner who takes no fee in specie, but makes the deluded patient pay very extravagant fees by the intolerable prices he puts on all cheap medicines, and by passing upon him very many more doses than the disease requires or the constitution can bear."

That this, the last quarter of our nineteenth century of progress and boasted enlightenment, is as rich in credulity and superstition as any of the preceding ones, is proved by the fact that thousands yearly visit shrines and sacred springs, if Catholics, and attend "faith conventions," if Protestants, to be cured of bodily ailments. Not long since one of England's proudest nobles traveled on a pilgrimage to Lourdes in the hopes that Notre Dame de Lourdes would make his only son, who is a deaf-mute, hear and speak. Every day in our own immediate neighborhood, hundreds and thousands of the maimed and the blind make pilgrimages to the sacred spring of Ste. Anne de Beaupré and are miraculously healed—have they not a mountain of crutches bearing witness to the fact? Lately in this city (Montreal), a noted female quack has made the blind to see and the lame to walk—at least I have been told so by eye-witnesses—and in consequence has attracted crowds of infatuated simpletons, who could not hand in their dollars fast enough to secure a bottle of her wonderful nostrum. The priests of a neighboring city, jealous of poaching on their own grounds, denounced her as a charlatan, and told the afflicted that, instead of being duped by this unholy woman, they should make a pilgrimage to Ste. Anne de Beaupré and be healed!

The success of this mode of treatment in hysterical cases is being recognized in France by physicians: they now, when they have an hysterical patient of a devout frame of mind, on whom they have exercised their skill in vain, as a *dernier ressort* advise that a visit should be made to the shrine of Notre Dame de Lourdes. Thus imagination often works a cure where medicine fails. These cures, as I said above, only take place when the disease is one of the imagination.

Why is quackery so much more prevalent in medicine than in any other science? Because the medical quack attributes to himself what is due to Nature. Nature can not build a railway, but she can very often cure disease. A witty Frenchman has said that medicine amuses the patient while Nature cures the disease.

Is there ever any chance of quackery becoming extinct? I fear not as long as human nature exists in its present condition. Still, no doubt, there is a probability of the number of believers in quackery being diminished by a greater diffusion of philosophical habits of thought and a more general knowledge of physiology. A writer many years ago, in one of the London medical papers, said: "The final

though distant extinction of quackery is to be hoped for; it forms a fragment of that final triumph of reason and virtue which is the secret consolation of every philanthropist."

RECENT MAGNETIC STORMS AND SUN-SPOTS.

By GARRETT P. SERVISS.

NO one who beheld the great auroral displays of last year can ever forget the impression that they made. They were among the most glorious celestial spectacles that have been witnessed in our latitudes. The first one occurred on the night of Sunday, April 16th. On the afternoon of that day I was watching with a telescope two complicated sun-spots, or groups of spots, one of enormous size, which had made their appearance on the solar disk several days before. My attention had been particularly attracted to these spots, both on account of their great size and because I thought I could perceive changes going on in them under my eyes. After watching them through the afternoon I became satisfied, about an hour before sundown, that the smaller spot, which was considerably in advance of the other, and was rapidly approaching the sun's meridian, had visibly increased in size while I had been watching it, and that perceptible changes had taken place in the complicated cluster of nuclei constituting the black center of the greater spot. It was evident that a tremendous outburst of solar forces was occurring; but, although I knew of the well-established connection between such convulsions in the sun and the condition of the earth's magnetic elements, I was not prepared for the spectacle that followed.

The sun had been below the horizon only long enough for the lengthening spring twilight to fade from view, when a pale-green arch of light was seen spanning a broad arc of the northern horizon, while above it the mysterious streamers and curtains of the aurora were waving and coruscating in the sky. So quickly had the earth responded to the magnetic impulse from the storm on the sun. The popular excitement caused by this aurora was remarkable, especially among those who were not aware of the nature of the strange illumination in the sky. People gathered in knots at the street-corners, and in the little parks of the city, and gazed wonderingly at the flaming heavens. Many seemed to be seized with a mingled feeling of admiration and dread. I crossed the Fulton Ferry after midnight, when the auroral streamers were yet shooting from horizon to zenith, and Arcturus was shining brilliantly in the center of a complete crown of greenish-yellow light near the zenith. A throng gathered at the bow of the boat to watch the display, which was much more brilliant when

seen from the center of the stream, away from the glare of the street-lamps. A decently-dressed and not unintelligent-looking man asked me, with a troubled look, and pointing to the heavens:

"What *is* that?"

"It's the aurora borealis," I replied.

He seemed relieved to find some one who could give it a name, and who did not appear to be alarmed.

"I thought it might be the comet the papers are talking about," he said, "and I didn't know what was going to happen."

I know that this man's vague fears were shared by others.

Everybody who had anything to do with telegraphs will remember the effects of the aurora. The wires played strange freaks. In some places they were disconnected from the batteries and worked by means of the current furnished by the magnetic storm; in other places they refused to work at all. The Atlantic cable was crippled, and at intervals, for several days thereafter, there was considerable delay of all telegraphic business. Subsequently it was learned that the auroral storm had raged, simultaneously, not only in the United States and Canada, but in Great Britain, on the Continent of Europe, and in Asia, extending clear across to the shores of China.

The next day, when I turned my telescope upon the sun, I was astonished at the changes that had taken place. The smaller spot, which I had seen increasing in magnitude on the previous day, had swollen to between five and six times its former size, so that now it was about half as large as the larger spot, and both were clearly visible to the unassisted eye, shaded with a dark glass.

I find by reference to the exact measurements of these spots, made at the Greenwich Observatory, that, whereas on the 16th the area of the smaller spot was to that of the larger about as 1 to 13·6, on the 17th the relative magnitudes were about as 1 to 2·2.

For three or four days afterward there were magnetic disturbances and occasional auroral displays at night, and during this time the activity of the solar forces continued.

On the 19th there was another magnetic storm, and coincidently with it the smaller spot suddenly increased in size again, until it was nearly as large as the other, and on the 21st it actually surpassed its neighbor in magnitude. After that both groups rapidly waned, the one which had undergone the remarkable development I have described fading much faster than the other one.

The next great display of sun-spots accompanied by auroras and magnetic disturbances—if we except one or two of minor importance and a somewhat remarkable one seen in Europe, which will be described hereafter—occurred in November last, culminating on the 17th of that month in one of the greatest magnetic storms on record, which crippled the telegraphs almost all over the civilized world. In Europe fine auroras were observed on the 12th, 13th, 14th, 15th, 16th,

17th, and 19th, accompanied by more or less magnetic disturbance. During that time a tremendous sun-spot, exceeding in size the largest of the April spots, was advancing from the edge of the disk to the center. In this country the principal auroral displays were on the nights of the 17th and 19th, and the chief force of the magnetic storm was felt on the 17th. On that day a storm of rain and snow prevailed over most of the Union, and simultaneously with this storm there raged a hurricane of magnetic forces. The effects were similar to those witnessed during the April storm, but more intense. As in April, some wires were worked without batteries, while others could not be worked at all. Cable communication was interrupted. Some startling phenomena occurred. Sparks of fire leaped from the wires and instruments. In the West, switch-boards were burned and keys melted. Operators received severe shocks. Practical telegraph men said they had never known such a powerful disturbance of the magnetic elements. In the evening, when the sky cleared at Chicago, a most magnificent sight was beheld in the heavens. The brilliancy of the aurora far exceeded that of the April display. A singular feature of this aurora, which was also noticed in Europe, was a splendid luminous arch spanning the sky from east to west and passing nearly through the zenith. Another feature that added brilliancy to the spectacle was the variety of color visible. The prevailing tints were rose-color and green, but in some places streamers and patches of violet, yellow, and orange light were seen. On the night of the 19th and morning of the 20th, the sky having cleared here, a splendid aurora was seen in New York. The magnetic disturbance also continued.

FIG. 1.

At the April meeting of the American Astronomical Society I exhibited some magic-lantern views representing the principal changes which took place in the great sun-spot during the magnetic storm of November. These views, copied from drawings of the spot made at the telescope, are reproduced in the accompanying cuts.

Fig. 1 represents the spot as it appeared on the 16th of November, the day before the culminating magnetic disturbance took place. Low magnifying powers, varying from sixty-five to a hundred and ten diameters, were used while making the drawings, as it was not desired to obtain pictures representing all the details. Consequently, only the

principal features of the spot are here represented, but the reader will be able to get a better general idea of the changes that occurred from such a picture than he could from one filled with minor details. The central and lower portions of the figure are especially worthy of attention because of the indications they give of an eddying motion corresponding with what should always be seen in a sun-spot according to Faye's cyclonic theory, but which, in fact, is rarely visible. It was also in these parts of the spot that the principal changes occurred, as will be seen by reference to the figures. It is very interesting to note that in Carrington's drawings of the remarkable sun-spot which accompanied the great magnetic storm of September, 1859—a disturbance whose effects strikingly resembled those produced by the storm of last November—similar indications of a whirling motion can be detected. Another exceedingly interesting fact is that in England, on the 16th of November last, luminous points were seen rapidly crossing the great spot. This forcibly recalls the similar phenomenon of flying points of light, seen by Carrington and Hodgson, darting across the spot of 1859, and which seemed to be a signal for the outbreak of the magnetic storm that followed.

FIG. 2.

In Fig. 2, which represents the spot as it appeared on the 18th, the day after the great magnetic storm, evidences of cyclonic motion are still, perhaps, visible, though they are rather suggested by a comparison of the appearance of the spot with that shown in the previous figure than by any clear indications in the figure itself unconnected with the other one. The roundish, nuclear mass near the center suggests by its form a whirlpool-like motion, but it is difficult on that hypothesis to account for the long, straight channel connecting it with the oblong figure on the right. The peculiar crooked figure seen in the lower part of the first picture has, it will be perceived, apparently broken up into several fragments, but this by itself is not inconsistent with the theory of an eddying motion.

Fig. 3 represents the appearance of the spot on November 19th, auroras and magnetic disturbances having in the mean time continued. Still further changes, it will be seen, have taken place, and the lower portion of the spot shows a tendency to separate from the larger mass above—a phenomenon that is of not unfrequent occurrence.

I find, by reference to my note-book, that other changes were visible on the 20th, but unfortunately I was prevented from sketching them. After that, unfavorable weather, and other interruptions, prevented me from sketching the spot, but the sketches that were made cover the period during which the most remarkable changes occurred, as well as that of the greatest magnetic disturbances. In order to

FIG. 3.

obtain a clear notion of the tremendous forces involved in the changes represented in the drawings, it is necessary to consider the enormous size of the spot as measured in square miles. Counting the whole area covered by the various nuclei and the penumbral depression surrounding them, the spot was not less than 60,000 miles long and 40,000 miles wide. In other words, it covered 2,400,000,000 square miles of the solar surface. The area of the whole surface of the earth, land and sea, is less than 200,000,000 square miles, so that if the crust of the earth had been peeled off like the skin of an orange, spread out flat and plastered against the sun, it would have looked like a mere outlying patch beside the great congeries of sun-chasms constituting this gigantic spot. Masses of gaseous matter, many times greater than the earth in volume, must have been hurled and whirled about there with tremendous velocity in order to produce the changes which the telescope revealed. Milton's description of the battling elements of chaos, through which Satan fought his way, will apply, though inadequately, to the scenes of chaotic fury of which such a sun-spot is the theatre.

In Fig. 4 is represented a very remarkable spot which, because it

made its appearance at about the time the great comet was in perihelion, in September last, and broke out on the portion of the solar globe which was nearest to the comet at that time, has been fancifully called the "black eye that the comet gave the sun." There were other spots visible at the same time and they also were ascribed by some to the influence of the comet. Some plausible reasons have been shown in favor of this view, and Professor Kirkwood's opinion that the great sun-spots of June, 1843, were caused by the large comet of that year has been freely quoted in support of it. Of course, the question whether this particular spot and its companions originated in some disturbance caused by the comet, whether by the fall of meteoric masses following in the comet's track or otherwise, can not be settled either way by positive evidence at present. But, while there are improbabilities in the way of the hypothesis, it may, at least, be said that, if any comet could produce a sun-spot without actually tumbling into the sun itself, the comet of last year ought to have been able to do it, for, as is known, it almost brushed the sun in its perihelion swing.

FIG. 4.

This great spot, however, is interesting on another account. The cut represents its appearance on October 1st, when it had reached about its greatest development. On October 2d there was a magnetic storm which was felt principally in Europe. The storm was very much less severe in its effects upon the telegraphs than those of April and November, but it was accompanied by the appearance throughout England, Scotland, and Western Europe of a most beautiful aurora.

In conclusion, it may be said that, while the evidence furnished by the great magnetic storms of last year was hardly needed to complete the chain of proof of the intimate connection between solar outbursts and the magnetic conditions prevailing upon our globe, yet this evidence was of such a striking character that it must rank among the most interesting of all that bears upon this question. It is, perhaps, worthy of remark that the period of sun-spot maximum through which we have just been passing has also furnished a good deal of evidence in favor of the views of those who think a connection can be traced between sun-spots and the weather. It is only necessary to point to the facts that 1881 and 1882, as well as the beginning of 1883, have been remarkable for cyclones, tornadoes, storms, and floods, and

that, coincidently with these meteorological disturbances, huge spots and other evidences of commotion have appeared in the sun. Here is a splendid field for investigation.

VIVISECTION IN THE STATE OF NEW YORK.

By BURT G. WILDER, M. D.

"I know that physiology can not possibly progress except by means of experiments on living animals, and I feel the deepest conviction that he who retards the progress of physiology commits a crime against mankind."—CHARLES DARWIN.*

THE objects of this article are—1. To enlarge the slender store of published facts respecting vivisection in the United States. 2. To discuss briefly certain general aspects of the question. 3. To examine the existing and proposed laws concerning it. 4. To consider Mr. Henry Bergh's fitness to initiate such legislation. 5. To express what seems to be the sentiment of most well-informed, humane persons regarding experimentation upon animals.

I. Aside from editorial articles and resolutions of medical societies, public discussion of vivisection in this, the State in which it is already somewhat limited by law, has been nearly confined to four gentlemen besides the present writer. Mr. Bergh's single contribution will be more conveniently considered later. Professor J. C. Dalton has contented himself hitherto with the general statement† that "the exhibition of pain in an experimental laboratory is an exceptional occurrence. As a rule, all the cutting operations are performed under the influence of ether. . . . This is because the infliction of pain is generally no part of the experimenter's object, and on every account it is preferable for him to avoid it." The foregoing refers directly only to laboratory investigations, and it may undoubtedly be inferred that, among the experiments before classes in the lecture-room, the painful constitute a still smaller minority.‡ What they have been is shown by Dr. A. J. Leffingwell# in quotations from the larger physiological treatises of Professors Dalton and Flint. Among the numerous illustrative operations mentioned as performed by these teachers in two of the largest medical schools in the coun-

* From a letter to Professor Holmgren, April, 1, 1881, published in "Nature," April 21, 1881, p. 583.

† "Experimentation upon Animals," etc., New York, 1875, p. 8.

‡ In a letter to the writer, dated January 11, 1883, Professor Austin Flint, Jr., says, "In my class demonstrations, I do not make experiments upon animals involving more pain than is caused, for example, by pithing to kill, or injecting an anæsthetic subcutaneously."

"Does Vivisection pay?" "Scribner's Monthly," July, 1880, pp. 391–399.

try, there appear to be seven in which anæsthetics are not always employed; in them, there is reason to believe that the pain inflicted is either brief or not very severe. There is also reason for believing that there is an annual decrease in the number of such demonstrations.

Mr. Bergh wishes to suppress vivisection by act of Legislature. Dr. Leffingwell would legally restrict painful experiments to original research under rigid surveillance. Professor Dalton seems to think no discussion of the subject is required.* Dr. L. S. Pilcher believes† it only necessary that "the public should be informed of the truth relating to vivisection in order that there should be secured to science every advantage and privilege which its advancement may need." The writer's communication‡ of two years ago, together with opinions which will be repeated at the close of this article, stated that he had taught physiology for twelve years in a university, and for half that time in a medical school, and yet had never performed a painful vivisection.

Since Cornell University owes its existence largely to the action of the State Legislature, and is bound by its charter to "receive, without charge for tuition, one student annually from each Assembly district," there are peculiar reasons for making known the exact condition of sentiment and practice therein with regard to vivisection. Aside from practical work in the laboratory, the physiological teaching comprises two courses of lectures, special and general. In the former, those who intend to become physicians, or to teach physiology, are made familiar with the details of experimental manipulation. In the latter, the verbal instruction is illustrated by experiments differing little from what are performed in some medical schools. The following are fair selections from these experiments:

1. A frog is killed by "pithing" with a sharp knife, and the brain is destroyed with a piece of wire. The mucous membrane of the roof of the mouth is removed, and the action of the cilia shown in various ways. 2. A frog is rendered motionless by the injection of a little curare under the skin. Two of the toes are tied apart, so as to stretch the intervening "web." The circulation of the blood is then observed under a microscope. Since it is not certain that sensibility is abrogated by curare, the animal is treated just as if it were in its normal condition, to which it commonly returns after a short time. 3. A pithed frog is employed for the demonstration of nervous, muscular, and reflex actions. Although the animal is dead as a whole, the irritability of its muscles and nerves and spinal cord persists for some time after the brain is destroyed or the head cut off. 4. From an anæsthetized frog the brain proper is removed. So long as the medulla remains, the respiratory movements continue; when it

* In the letter already mentioned, Professor Flint says, "I think investigators and teachers should be the sole judges as to what is necessary in their investigations and teachings."

† "How Vivisection concerns Every Citizen," "Christian Advocate," July, 1880.

‡ "The Two Kinds of Vivisection—Sentisection and Callisection," "Medical Record," August 21, 1880.

is destroyed, they cease. 5. A cat is etherized, inhaling the anæsthetic slowly and without apparent discomfort in a glass box made for the purpose. The trachea is opened, and a glass tube inserted. This is then connected with a U-shaped tube partly filled with a colored liquid; the effect of the respiratory movements in expanding the lungs is shown by the oscillation of the liquid. 6. With an etherized cat the trachea is connected with a pair of bellows. The medulla is cut and the lungs are artificially inflated with the bellows. In this way the heart is kept beating while the entire ventral wall of the chest is removed and the heart exposed to view. If removed from the body, the heart soon ceases to beat. 7. With a cat, anæsthetized and then pithed, the respiratory muscles are stimulated directly or through their nerves. 8. From an anæsthetized frog the cerebral hemispheres are removed. After recovering from the operation, such a frog may remain for weeks in a stupid condition, neither moving nor feeding voluntarily, although it can swim, balance itself on the edge of a board, and swallow food placed in the throat. It thus approximately exemplifies the life of some idiots. 9. A cat is etherized, and part of the right hemisphere exposed. A light interrupted current of electricity is applied to certain spots, and the invariable response is by definite movements of the limbs of the opposite side. Other regions give no response at all. 10. With an etherized cat the vagus nerves are exposed in the neck. A large needle, with a head of red wax, is passed through the skin and muscles, so that its point is fixed in the heart, the pulsations of which are then indicated by the oscillations of the head. When a somewhat strong interrupted current of electricity is sent through one or both of the nerves, the heart beats more slowly, or stops altogether. The current is stopped, and the pulsations recommence. The nerves are then cut, and the heart beats more rapidly, but the respiratory movements are slowed. In this, as in all other experiments under anæsthetics, the animal is killed before revival.

The significance of these and similar experiments may be ascertained from any physiological treatise or well-educated physician. Only the first and the last can be commented on here. Cilia are minute filaments of protoplasm which, among other localities, cover the surface of the membrane which lines the air-passages. Independently of the will they keep up a rapid lashing movement, more forcible in one direction, so that the dust inhaled with the air is continually swept from the smaller tubes into the larger, and so to the larynx, whence it is voluntarily expelled. If we reflect upon the inevitable consequences of a vacation, or "strike," of these millions of irresponsible "sweeps," we shall feel it well worth while to inform ourselves as to their appearance and mode of action, even though the acquisition of this knowledge costs the lives of many frogs. The last experiment affords some clew to the nervous mechanism through which the action of the heart may be accelerated or retarded, or wholly checked on account of violent physical or mental impressions. Who that has felt his heart "flutter," or "stand still," would not, even in a slight degree, fathom the mystery which still surrounds the relations of our bodily organs to each other and to the mind?

Those who denounce all vivisection as "barbarous" are asked to

note that the performance of the ten experiments above described involves only the pain of a hypodermic injection or of pithing, since, whenever the animal is alive during the operation, complete insensibility is produced by anæsthetics. Most of the experiments, however, are done upon dead animals—that is, a man treated in like manner would be legally defunct. In the ordinary sense of the word, therefore, such experiments are not vivisections at all, although they are so by virtue of the persistence of vitality in certain organs and tissues.* According to information from various sources, it is probable that the large majority of experiments in this State, whether in medical colleges or other institutions, whether for research or for teaching, are, like those described above, performed upon animals completely anæsthetized or actually dead.†

II. Many persons find it difficult to dissociate the word *vivisection* from the sufferings which were, perhaps, unavoidable before the discovery of ether and chloroform, and from those which are inflicted at the present day by careless or unfeeling experimenters. The proposed laws likewise ignore the difference between experiments in respect to pain. In England the question has been similarly befogged by the use of a single term for two different ideas. In the face of the official reports showing, according to Dr. Gerald Yeo's later estimate,‡ that only twenty-five out of one hundred experiments caused any pain at all, Frances Power Cobbe has the hardihood to say,* "We find it practically impossible to separate torturing from non-torturing vivisection." In view of all this ambiguity, whether due to ignorance or design, I have ventured to suggest ‖ that painful vivisection be known as *sentisection*, and painless vivisection as *callisection*. The desirability of some verbal distinction was presented to Mr. Bergh, both in the article referred to and in private letters, dated February, 1880, and October, 1882. His only reply is the following, dated November 3,

* It is stated that the Danish Society for the Prevention of Cruelty to Animals has offered a prize for the best essay upon the performance of physiological experiments upon recently killed animals.

† Opinions to the same effect have been expressed by well-known teachers in a sister State, and in Great Britain. In "Scribner's Monthly," September, 1880, page 766, Professor Horatio C. Wood says, "So far as concerns the medical schools of Philadelphia, vivisection without anæsthetics is not practiced to any extent, if at all, for class demonstration." In "The Popular Science Monthly," April, 1874, Professor Michael Foster says, "So far as I know, in this country at least, physiologists always use anæsthetics when they can." See also the very comprehensive and important "Facts and Considerations Relating to the Practice of Scientific Experiments on Living Animals, commonly called Vivisection," issued by the Association for the Advancement of Medicine by Research, "Nature," March 13, 1883, which appeared after this article was in type.

‡ "The Practice of Vivisection in England," "Fortnightly Review," March 1, 1882, pp. 352–368.

* "Vivisection: Four Replies," "Fortnightly Review," January 1, 1882, pp. 88–104.

‖ In the article referred to on page 170.

1882: "Pardon me for saying that 'if the rose would smell as sweet by any other name,' surely the blood of tortured animals would also retain its repulsive odor under any other designation." Perhaps Mr. Bergh and Miss Cobbe vaguely apprehend that, should the intelligent people of their respective lands once realize that three fourths or more of what are indiscriminately stigmatized as vivisections are absolutely painless, their denunciations would have little weight, their occupations would be gone.

Specific repressive legislation is commonly directed against the ignorant or the vicious. Laws for the suppression of vivisection stand almost alone as aimed against those who are charged with the mental and physical welfare of the community, and whose official positions and social relations would enable them to further materially the general objects of the Society for the Prevention of Cruelty to Animals. I am not aware of any action upon the part of the teachers of this State respecting Mr. Bergh's efforts to deprive them of the most effective means of illustrating physiology, but the sentiment of the medical profession has been clearly expressed. As stated by Dr. Dalton,* and in the "Medical Record" for February 28, 1880, and February 10, 1883, Resolutions affirming the value of experiments upon animals, and deprecating legislative interference therewith, have been adopted by seven medical schools of the State, by the State Medical Society, and by sixteen organizations representing various localities or special branches of the science. It is hardly to be expected that many physicians† or teachers will enroll themselves under the banner of humanity to animals so long as the same staff carries the black flag of anti-vivisection, which in their eyes is inhumanity to man.

Few educated persons doubt that experimental physiology has practically contributed something to human welfare, and the probability or even possibility that knowledge so gained might save the life or the health of a single child must be felt, at least by the parents of that child, to justify the sacrifice of "a wilderness of monkeys," not to mention lower forms. Naturally, therefore, among the writers in favor of vivisection, nearly all have confined their arguments to the medical and surgical advances which have been made or aided thereby. Some (Dalton, Foster, Leffingwell, and Yeo) have implied, perhaps unintentionally, that physiology appertains only to medical science; while others (Owen, Tait, etc.),‡ defenders as well as opposers of vivisec-

* "Experimentation upon Animals," chapter iv.

† According to the Report for 1882, the American Society for the Prevention of Cruelty to Animals contains four hundred and two members or donors. *Four* of them are physicians.

‡ Richard Owen, "Experimental Physiology, its Benefits to Mankind," etc., London, 1882; Lawson Tait, "The Uselessness of Vivisection upon Animals as a Means of Scientific Research," "Transactions of the Birmingham Philosophical Society," April 20, 1882; G. F. Yeo, "Vivisection and Practical Medicine," "Popular Science Monthly," March, 1883.

tion, exclude it from the category of appliances for instruction. Yielding to none in my conviction of the indispensableness of experiments on animals to the prevention and healing of disease and injury, I believe that a higher and broader ground should be taken. "The knowledge of the human body," whether gained by dissection or by experiment, "belongs to every man, woman, and child, and has no more exclusive connection with physic than with law, engineering, or architecture." Consequently, had vivisection accomplished absolutely nothing for medicine or surgery, nevertheless experiments upon animals, necessarily painful in some cases, should be performed by competent persons for the advancement of physiological knowledge, just as experiments are done in chemical and physical research, and *experiments, commonly painless, should be constantly employed in physiological teaching, simply because the information so imparted is more interesting, more intelligible, and more lasting than what is given in any other way.** The spirit and methods of modern scientific teaching are well conveyed in the motto, "*Iter longum per præcepta, breve per exempla*," to which may be added the metric imitation of a familiar proverb, "A gramme of experiment is worth a kilogramme of talk." Logically, indeed, unless it be wrong to *kill* animals for the sake of mental acquisition, the exclusion of painless experiments from physiological teaching would be comparable with the abolition of museums, models, and *vivaria* of all kinds because most animals have been figured and described. On this point most persons will admit the force of Dr. Bartholow's query, "If animals are sacrificed for the support of men's bodies, why should they not contribute to the improvement of men's minds?"†

III. "An act for the more effectual prevention of cruelty to animals," passed April 12, 1867, embraces two sections relating to experimentation upon animals:

SECTION 1. If any person shall overdrive, overload, torture, torment, deprive of necessary sustenance, or *unnecessarily*‡ or cruelly beat, or needlessly mutilate or *kill*, or cause or procure to be overdriven, . . . or needlessly mutilated or killed, as aforesaid, any living creature, every such offender shall, for every such offense, be guilty of a misdemeanor. . . .

SEC. 10. Nothing in this act shall be construed to prohibit or interfere with any *properly conducted* scientific experiments or investigations, which experiments shall be performed only under the authority of some regularly incorporated *medical college or university* of the State of New York.

The following is the bill for the total suppression of vivisection

* As has been pithily stated by Huxley at the close of an article "On Elementary Instruction in Physiology," "Popular Science Monthly," October, 1877.

† Lecture reported in the "Medical Record," October 11, 1879, p. 342.

‡ Certain words of this and the following extracts are italicized with reference to comments which will be made presently.

which has been introduced, at the instance of Mr. Bergh, at the last three sessions of the Legislature:

SECTION 1. Every person who shall perform, or cause to be performed, or assist in performing, in or upon any living animal, an act of vivisection, shall be guilty of a misdemeanor.

SEC. 2. The term *vivisection* used in this act shall include every investigation, experiment, or demonstration, producing, or of a nature to produce, pain or disease in any living animal, including the *cutting*, wounding, or poisoning thereof; except when the same is for the purpose of curing or alleviating some physical suffering or disease in such living animal, or in order to deprive it of life when incurable.

Whether or not this law would, or is designed to, interfere with the slaughtering of animals for food, or with the extermination of pests, or even with the drowning or suffocation of impounded dogs under the supervision of Mr. Bergh's Society, does not especially concern physiologists; but the points indicated by the italicized words are worthy of consideration. In the law of 1867, the words *needlessly* and *properly* are used. In the absence of specification as to who shall determine what is needless or proper, would not the decision rest with the administrators and executors of the law? If so, might not the first section be so interpreted as to permit any amount of pain as "needful" for scientific purposes? Other magistrates and police, on the contrary, might deny the "propriety" of any experiment upon living creatures, and thus interdict everything of the kind under the tenth and apparently permissive section. The tenth section expressly restricts even "properly conducted experiments" to medical colleges and universities. Pending the elimination of this impediment to the advancement and diffusion of physiological knowledge by private individuals and by the teachers in the normal and other schools, it is to be hoped that the clause may be interpreted as liberally as are the Sunday laws of the "New Penal Code." The peroration of Mr. Bergh's vivisection address puts the following words into the mouth of a "victim": "If my life be necessary to you, take it." The most natural interpretation of this sentence is that, in the mind of its author, the advancement or dissemination of human knowledge is sufficient justification for putting an animal to death. But his proposed law permits no cutting, wounding, or poisoning excepting for the sake of the animal itself. What are we to understand upon this fundamental question?*

Respecting the last section of the law of 1867, Mr. Bergh says,

* On the 23d of December, 1882, I addressed Mr. Bergh a letter asking whether his bill is designed to prohibit the following operations: confining the animal with cords or bandages; subcutaneous injection of curare; killing by pithing; experimenting under anæsthetics, the subject being killed before revival; experimenting under anæsthetics, the animal being allowed to revive, and to endure the healing of clean incisions. Notwithstanding a later request for attention, no reply has been received.

"So long as this remains unrepealed, these scientific horrors, which I hold to be an insult to the Deity and to the civilization of our generation, will proceed." * Let us see what facts Mr. Bergh has to offer in support of so decided a condemnation. Of his Vivisection Address, several pages are occupied with descriptions of more or less cruel European experiments, and with lurid comments thereon; *a single page is devoted to a single New York case.* Immediately after dwelling at some length upon the atrocities perpetrated in the veterinary school at Alfort, in France, he says: "Those of you who have been able to listen to the recitals I have just made, will, perchance, experience a glow of national pride at the thonght that such devilish deeds are impossible in this happy land of yours; but your self-gratulation is but partially true, as I have lately had occasion to verify. On the 19th of December, 1879, I dispatched an officer of the society I represent to attend an exhibition of a similar sort at one of the colleges of the city of New York. . . . A live dog was brought in, said to be under the influence of an anæsthetic." The rest of the description indicates that the experiment was the same as No. 6 of those mentioned upon page 171. So far, therefore, as depends upon the evidence furnished by Mr. Bergh, to evoke the law for the suppression of vivisection in the State of New York, because formerly anæsthetics were unknown, and because in France they are still too often unemployed, is as if an army were summoned for the extermination of the panthers in the "North Woods," upon the pleas that they were numerous and dangerous not many years ago, and that at the present time in India thousands of people are annually slain by tigers.

So far as I can ascertain, Mr. Bergh is not only the originator and instigator of the anti-vivisection legislation in this State, but almost its sole supporter. No articles by members of his society have come to my notice. According to the "Medical Record" for March 13, 1880 (page 292), in that year but a single vote was cast in the Assembly against the acceptance of the adverse report of the committee to which his bill had been referred. Its fate at the last session is thus announced in the Annual Report of his Society: "That sum of all physiological villainy, vivisection, which I again recommended to the consideration of that sapient State congress which was characterized by a portion of the press as a 'mob,' has been remorselessly, and at the bidding of a heartless and opinionated medical faculty, disrespectfully slaughtered as before."

Nevertheless, in a letter dated November 24, 1882, Mr. Bergh says, "I am not quite sure whether I shall introduce a vivisection bill at the ensuing session"; and in view of what has taken place in England, at first sight a most unlikely nursery for any movement in behalf of animals, it may be well to consider somewhat carefully his qualifications for leadership in a movement of such importance.

* Vivisection address, 1880, p. 24.

IV. The experiment above mentioned is characterized by Mr. Bergh as "the crucifixion of a sentient, unoffending being, . . . an immortal work of the Deity." The grave question of the immortality of animals need not be discussed here. The adjective *unoffending* is objectionable merely because, like so many other words used by the same writer, it tends to throw a sentimental film over the eyes of logic and severe justice through which the whole matter should be viewed, and it is altogether probable that the dog thus utilized for the exemplification of several important physiological truths was, like most vivisection "subjects," a worthless street cur whose death, in the manner described, was a relief to the community, and a positive deliverance from a worse fate through hunger or cold, or at the hands of ill-regulated boys. But, in the entire absence of evidence that the animal was conscious, the use of the words *sentient*, *crucifixion*, and *exhibition of a similar sort* constitutes an exaggeration so great and so mischievous that it can not be lightly passed. It is akin to affirmations in other parts of the address: "The effect of curare in itself is horrible beyond conception; . . . it is an error to suppose that anæsthetics subdue completely the pain of operations; . . . the hands of the preceptors in our medical colleges are daily incarnated with the warm blood of tortured animals ruthlessly slaughtered." If, with Huxley, we hold that "the assertion that outstrips evidence is not only a blunder but a crime," the offenses of Mr. Bergh are too many for enumeration here.

The "quotations" upon which Mr. Bergh bases the surprising claim* that "vivisection has been the subject of universal condemnation by the more eminent members of the medical profession in Europe," have been scrutinized by Dr. Dalton.† After showing that Professor W. B. Carpenter expressly repudiates the views attributed to him, Dr. Dalton inquires: "What shall we call this manipulation of the facts used to convey an impression at variance with the reality? If we did not know that it came from a professional philanthropist, we should be inclined to give it a very awkward name." Again: "If confinement in State-prison were the legal penalty for tampering with an author's opinions and falsifying his language, I am afraid Mr. Bergh would have been there long ago."

It can hardly be denied that, taken by themselves, some of Mr. Bergh's affirmations and accusations suggest that his hatred of vivisection is stronger than his love for courtesy and truth, and if the argument *sævus in Europa, sævus in America*, which is really all he has to offer against New York physiologists, were turned against him in the original form of *falsus in uno, falsus in omnibus*, the advocates of unlimited dog-fights and cocking-mains might well object to the recognition of such a witness against their favorite sports. But, when all

* "Memorial to the Legislature," 1880, section 5.

† "Mr. Bergh as a Commentator," "The Nation," October 16, November 6 and 20, 1879.

else is considered, the evidence proves too much. The man of pure and upright life; the heroic defender of the weak against the brutal; the tireless organizer of a society, for the main object of which he has secured legislative and legal co-operation, and the sympathy of the better part of the community, surely such a man can not be a common scold and an habitual liar.

Is there a less harsh alternative? After thoughtful consideration of nearly all Mr. Bergh's published writings, and of several courteous private letters, I conclude that, in regard to experimentation upon animals he is not morally perverse, but mentally incapacitated for accurate observation, correct quotation, logical argument, or legitimate conclusion; that, in short, so far as vivisection is concerned, he is of unsound mind.* This charitable view of his character may serve to explain passages like the following:† "As another proof of the profane extremes to which these dissectors of living animals will go, Robert McDonald, M. D., declared that he had opened the veins of a dying person, remember, and had injected the blood of an animal into them, many times, and had met with brilliant success. In other words, this potentate has discovered the means of thwarting the decrees of Providence, where a person was dying, and snatching away from its Maker a soul which he had called away from earth."‡

In view of all these things, is Mr. Bergh's single-handed crusade against practical physiology anything more than an unintentional burlesque of reform? Is it compatible with the highest usefulness of the society which he represents or with the dignity of the Legislature of a great State that he should be permitted to repeat the fiasco? Should he persist, in open disregard of his own dictum, "Laws can not precede public opinion, but must be the outgrowth of that opinion," the interests of humanity in its widest sense would certainly be promoted in this State by the authoritative assurance that his extreme views are not shared by the American Society for the Prevention of Cruelty to Animals.

V. The concluding division of this article combines: A. A summary of the facts and views already presented; B. A brief statement of certain matters which could not be fully discussed on this occasion; C. An expression of what I believe to be the sentiment of unprejudiced, humane, well-informed persons respecting the legitimacy of experiments upon animals and the desirability of legal interference therewith.

* This idea is suggested, perhaps without design, in Dr. Dalton's characterization of Mr. Bergh's attack upon Magendie as "crazy maledictions." "Magendie as a Physiologist," "International Review," February, 1880.

† Vivisection address, p. 15.

‡ See also his letter respecting experiments upon transfusion, "New York Evening Post," Feb. 28, 1883.

1. The object of an experiment may be the advancement of knowledge by research, or its diffusion by teaching.

2. In respect to the infliction of pain and death, experiments are of four kinds: (1.) The animal has been recently killed; (2.) The animal is rendered insensible by anæsthetics and killed before revival; (3.) Anæsthetics are used during the experiment, but the animal revives and endures the healing of wounds; (4.) Without anæsthetics, the animal is subjected to cutting operations, or to the effects of poisons or of insufficient food.

3. All experiments at Cornell University belong to the first two groups. Of all the experiments performed during the past year in the State of New York, whether for research or instruction, probably less than one tenth would come under the fourth class, and not more than one tenth under the third. In view of what is learned from these experiments, the total amount of pain and death inflicted is insignificant.

4. It is desirable to make a verbal distinction between painful and painless experiments, and to adopt a single term in place of the phrase experimentation upon animals.*

5. Over and above the utilitarian argument drawn from its subserviency to medical science, physiology should be pursued and illustrated experimentally like chemistry or physics, because it is a most interesting and suggestive branch of knowledge.

6. In the State of New York are very few men whose natural and acquired powers of body and mind qualify them to determine when painful experiments are required, to perform them successfully, and to wisely interpret the results. Such men, deserving alike of the highest honor and the deepest pity, should exercise their solemn office not only unrestrained by law, but upheld by public sentiment.

7. All teachers of physiology, from primary schools to universities, should illustrate their instruction by experiments upon animals, chiefly if not wholly painless.

8. All experiments should indirectly inculcate humanity to animals. The victims should be treated with respect on account of what is learned from them, and with gentleness because "cruelty to animals is the beginning of cruelty to man." Even the administration of anæsthetics should cause the least possible discomfort.

9. The abolition of vivisection in the State of New York is demanded by a single individual, who has not as yet displayed the necessary qualifications for dealing with so large a problem. The laws proposed by him are vaguely framed, and inconsistent with his own utterances upon the subject.

10. A single physician has advocated legal restriction of painful

* Such a term is zoöpery, from the Greek ζοον, *an animal*, and πειραω, *I experiment*. By inflection we get *zoöperal, relating to experimentation on animals, and zoöperist, one who performs such experiments*. In this connection, it is to be noted that many experiments are upon dead animals, and some involve no cutting at all.

experiments. Otherwise, so far as appears from published resolutions, legislative interference is opposed by the medical profession of this State.

11. Judging from English experience, the interdiction of all vivisection would seriously impede the progress of physiology in this State.

12. While physiologists justly resent attacks grounded in ignorance and maudlin sentimentality, they should avoid and discountenance even the appearance of bravado and indifference to the suffering of animals.

13. So long as the people and the Legislature are satisfied that physiological investigators and teachers regard the infliction of pain as undesirable on every account, no legal restrictions are likely to be put upon vivisection in the State of New York.

QUARTZ: ITS VARIETIES AND FORMATION.

By Rev. J. MAGENS MELLO, F. G. S.

QUARTZ is in its many forms probably the most abundant, as well as one of the most beautiful, of all the various minerals which enter into the formation of the earth's rocky surface. To describe it and its principal varieties, and to give a short sketch of the modes of its occurrence and of its formation, will be the object of this paper. Among the elements known to chemistry is one named silicon, sometimes called silicium; the oxide of this substance, which is never found in a free state in nature, constitutes silica, the chemical name for quartz and all its varieties. Its pure crystallized form is familiar to us as the colorless and transparent rock-crystal.

As rock-crystal, the typical form of quartz, is an hexagonal prism terminated at each end by a rhombohedron, when broken it will be seen to have a conchoidal or splintery fracture. Rock-crystal is very widely distributed, being found in rocks of all ages. The most beautiful and perfect specimens are usually obtained from large cavities or geodes in the older igneous rocks, and also from veins in these and other rocks. The size and color of quartz-crystals vary greatly; some are so small as to be microscopical, while others are of very considerable bulk. In the museum of Berne may be seen specimens of both the clear rock-crystal and also of black or smoky quartz upward of a foot in length; there are also some very large ones in the British Museum. Quartz-crystals are often found presenting almost every shade of color—yellow, brown, black, red, blue, violet, and green. Various names have been given to these colored varieties. The violet, blue, and some of the yellow, and even of the white crystals, which, when

fractured, are seen to have a peculiar undulated structure, which Sir D. Brewster pointed out, have been classed together as amethysts, a name often popularly restricted to the violet crystals, which owe their beautiful tint to the presence of oxide of manganese. Violet amethysts are not uncommon in the geodes occurring in volcanic rocks in many localities; but the finest are obtained from Siberia, Persia, India, and Ceylon; while Brazil yields white and yellow amethysts. The yellow and brown crystals known as cairngorms are varieties of rock-crystal or of crystallized quartz, if we restrict the term rock-crystal to the clear, colorless specimens. The darker brown and black crystals, as well as those designated as cairngorms, may be grouped under the common name of smoky quartz. The dark-green quartz is called prase, and is colored by amphibole; there is also a lighter green species known as chrysoprase, tinted, it is said, by oxide of nickel; while oxide of iron probably gives color to the numerous red varieties. The common milk-white quartz, which is the ordinary quartz of veins and of quartz-rock, will be found, on microscopical examination, to be really transparent, but so full of minute cavities as to cause it to assume its milky opacity.

Quartz-rock, or massive quartz, is often found in mountainous masses, hundreds of feet in thickness. Many of the quartz schists and micaceous schists consist chiefly of quartz irregularly split up by thin leaflets of mica. Sandstone rocks, often consisting of little besides more or less rolled grains of quartz, will have been derived from the breaking up, under various denuding agencies, of rocks in which quartz has been the prevailing mineral. Veins of quartz have already been mentioned. These are very frequent in the old slate and schist rocks, sometimes forming broad and irregular bands; at others, mere threads traversing the other materials. Such veins will often present open spaces in which the quartz will be found regularly crystallized.

Flint and chert are forms of quartz usually occurring as concretions in limestone rocks; sometimes, however, as bands of considerable thickness. The black color so common to the flints of the chalk formation and to the chert nodules and bands in the mountain limestone is due to the presence of carbon. Hornstone is merely a variety of chert.

Chalcedony has been described as a mixture of crystalline and amorphous quartz; its tendency is to assume a botryoidal or stalactitic form; and its numerous variations of color and modes of occurrence have led to the adoption of different distinguishing names. Carnelians and sardes are only color distinctions of chalcedony; and the immense family of agates, including the onyx and sardonyx, is more or less composed of chalcedony, disposed in layers, regular or irregular, and combined with other forms of quartz, such as amethyst, jasper, etc. This latter name is applied to an aluminous variety of quartz: it is opaque, and has a less crystalline appearance than ordi-

nary quartz. It is very varied in color: some beautiful red, brown, and green-banded stones are obtained in Siberia, in Egypt, and elsewhere. Bloodstone is considered to be a mixture of chalcedony and jasper, colored by metallic oxides. One of the most beautiful forms of quartz is opal, which is nothing more than amorphous silica combined with water, which has filtered out from the rocks, usually igneous ones, and is found in cavities and fissures in those rocks. Bohemia, Hungary, Auvergne, and Queensland yield opals, some of them of great beauty and value.

Having thus briefly pointed out the principal varieties of quartz, and the modes of their occurrence, we will next turn to the history of their formation. We shall find that quartz may have been formed by more than one process in the grand laboratory of Nature. According to Cotta, there are two modifications of chemical composition in quartz, which are distinguished by their different degrees of solubility. "The one is insoluble in water and in every acid except hydrofluoric, and the other is soluble in water at high temperatures, especially in the presence of other acids and alkalies." The insoluble variety of quartz may, it is said, in process of time become "converted into the soluble by the contact-influence of infiltrated moisture." It may, however, be noted that ordinary quartz, if fused with carbonate of soda, becomes soluble in water, and from this solution gelatinous silica is precipitated by hydric chloride. Years ago it was noted that silica when combined with an alkali is soluble in water, and that thus the decomposition of feldspar might in some instances be a source of silica in solution. The residue of decomposed feldspar, when it has been examined, has been found to contain only a portion of the silica due to it, the remainder having been dissolved. In a similar manner mica is another mineral which may be a source of supply for pure silica. A fact of some importance in studying the mode of the formation of quartz is that, unlike feldspar and other minerals, which in crystallizing pass at once from the fluid to the solid state, quartz passes through an intermediate viscous or colloid condition before it assumes the crystalline form. It is, comparatively speaking, only very recently that we have had any practical acquaintance with this colloidal form of silica. The late Mr. T. Graham, by his most valuable experiments in dialysis, succeeded in obtaining pure silica dissolved in water, which rapidly assumed a gelatinous condition.

The three principal agencies that have taken part in the formation of quartz are heat, water, and organic life. When we examine, by the aid of the microscope, certain forms of quartz, such, for instance, as the crystals occurring in some of the quartz porphyries, and occasionally in the pitchstones, as well as much of the quartz of granite rocks, we find that they contain minute cavities which inclose very frequently tiny crystals of other minerals; in the quartz of granite these are very often found to be alkaline chlorides, or sometimes the

cavities are filled up with glassy mineral matter—as, for instance, in the quartz of some of the Icelandic trachytes. Other cavities are found, especially in the granitic quartz, filled with gas, or sometimes with water, or liquid carbonic acid. In these latter cavities small bubbles will be found which are movable; the smaller ones, indeed, appear to be endowed with a kind of perpetual motion of their own. The quartz in these rocks must have crystallized at a very high temperature—indeed, where glass cavities occur, from a state of true igneous fusion. Mr. Sorby has shown that the solvent power of liquid water at the temperature of about 412° C. is very great: its action on glass has been such as to produce quartz-crystals from it.

There seems to be clear proof that the quartz of the granite rocks which contains partially filled fluid cavities, and cavities inclosing crystals of common salt, etc., has been formed in a partially melted mass of rock, and began to crystallize when that mass was exposed to the solvent action of liquid water, at a temperature not far below 400° C., but yet not sufficiently high to expand the water into steam. Mr. Sorby concludes that "by far the larger part of the quartz in granitic rocks was set free and crystallized through the action of liquid water, at a temperature of a dull-red heat, just visible in the dark. The exact temperature may, however, have varied considerably, since, if the pressure were not sufficiently great, the water might remain in the form of steam until the rock had cooled somewhat more." It has been noticed as somewhat remarkable that the quartz in granite should have been usually the last mineral to crystallize, although it is that one which is the most difficult to fuse, and which would therefore naturally be expected to have been solidified before the feldspar and the mica. But it has been shown that, when quartz is in combination with other mineral substances, it is often as readily fusible as they are; and thus what must be called accidental circumstances may have led, in the case of the rocks in question, to its being crystallized after the feldspar, which we so generally find to have modified the form of the quartz; this latter appearing as a glassy paste inclosing the accompanying minerals, instead of having a definite form of its own. It has also been observed that the feldspar in solidifying would liberate a sufficient quantity of heat to enable the quartz to retain its viscous state (Durocher); just as, on the other hand, in the quartz porphyries we see an instance of the analogous effect of the crystallizing quartz upon the feldspar. It is asked how the enormous masses of quartz which form some of the schistose rocks can have been produced? We must appeal to metamorphism. The contact of highly-heated eruptive matter might thus alter a quartz or sandstone into an almost pure quartz-rock. Heat and pressure combined are mighty agents, which might also effect a similar change during the course of long ages.

That water at a high temperature can hold quartz in solution is well illustrated by the deposits of silicious sinter, thrown down by

thermal springs, as, for instance, the geysers of Iceland, and by others in Kamchatka and in New Zealand: this silica often incrusts mosses and other substances in the same way that we may see calc-tuff forming petrifactions in other localities. The delicate, feathery crystallizations of silicious sinter are extremely beautiful.

The quartz of veins appears generally to have been deposited from aqueous solution, and will be seen, as has been already remarked, to contain innumerable cavities inclosing water. Occasionally these watery cavities are of large size, and may be observed without any instrumental aid.

Among the most varied and beautiful forms of quartz which have had a purely aqueous origin are all the varieties of crystalline and amorphous silica, which frequently coat the interiors of geodes and other hollow spaces in the igneous rocks, and which consist chiefly of an intermingling of chalcedony and jasper, and are conveniently grouped under the general name of agates. Pure rock-crystal, amethyst, cairngorm, and other valuable crystallized forms of quartz, are often found in connection with the same rocks, or in others of a more purely metamorphic character. All these varieties of quartz are secondary formations, deposited from watery solutions. The exact mode in which agates have originated is a question full of interest, and not easy in every case to answer. A wonderful history of mineral growth is written in the folded leaves, if one may so denote the bands of a single agate. A very large number of agates consist of more or less concentric layers of chalcedony of various colors (the colors depending on the presence of metallic oxides), together with jasper, rock-crystal, amethyst, etc., in many cases.

Chalcedony is sometimes described as a reniform condition of silica, and though apparently amorphous, when it is microscopically examined, it generally, if not always, exhibits a minute and definite radiated crystalline structure. It frequently forms stalactites, and many of the most exquisite of the banded agates are sections cut from stalactitic formations. Jasper may be looked upon as chalcedony, which, as it consolidated, caught up a certain amount of alumina, or sometimes of lime or oxide of iron. Professor Ruskin, who has paid some attention to this subject, has observed that "jasper will collect itself pisolitically out of an amorphous mass into a concretion round central points, but does not actively terminate its external surface by spherical curves; while chalcedony will energetically so terminate itself externally, but will, in ordinary cases, only develop its pisolitic structure subordinately, by forming parallel bands round any rough surface it has to cover, without collecting into spheres, unless provoked to do so by the introduction of a foreign substance, or encouraged to do so by accidentally favorable conditions of repose."

According to the same observer, some agates appear to be of the nature of concretions formed from within, round a nucleus; these

would consist of chalcedony or jasper in the inner portions, and have distinctly crystallized exteriors. There is another class of agates composed of external bands of chalcedony or jasper, stalactitically deposited in a cavity which may either have a hollow center, or one filled up with crystals of quartz. There appear, however, to be intermediate varieties in which concretionary or stalactitic formations have been combined with, or interrupted by, other modes of growth.

Some of the most curious and beautiful agates are those containing dendritic crystallizations; in these we see, in the more or less transparent chalcedony, which in these agates is not banded, wonderful mossy or confervoid-like growths, often very closely resembling vegetable forms. The valuable stones from Mocha contain ferruginous brown or black inclosures, while some of the dendritic agates from India are filled with a bright-green network of what appear to be filaments of confervæ. These dendritic forms in the moss-agates are mostly the oxides of iron or manganese; or in the green Indian pebbles, delessite or chlorite. The question of their origin is a difficult one. In some agates the dendrites may have resulted from a segregation of the oxides of the metals from the colloid or partially crystallized silica; in other cases they may be the effect of subsequent infiltrations; or, again, the quartz may have been consolidated around previously existing crystallizations. With regard to infiltration by these oxides, it is well known that even the most compact-looking chalcedony is permeable, as it is possible by steeping it in solutions of the aniline or other dyes to impart the most brilliant tints to agates, the dye undoubtedly gaining access to the interior of the specimen through the interspaces of its minutely crystalline structure.

In a large group of agates, of which beautiful specimens come from India, an appearance of banded formation is seen, which, upon microscopic examination, resolves itself into an infinite number of red or brown spots, regularly arranged in bands or concentric groups: these spots appear to be segregations of oxide of iron. I have not seen a specimen of this species of agate cut sufficiently thin to show whether the arrangement of these minute spots is dependent upon a banded structure in the chalcedony itself, or whether it is independent and the result of molecular force which has determined the arrangement in question. It may here be noticed that a vast number of the Indian agates come from the neighborhood of the Gulf of Cambay. Near Turkeysar there are agate conglomerates intercalated between beds of laterite which belong to the Eocene period. These conglomerates we may suppose to have been derived from the denudation of the earlier igneous rocks which abound in the same district. Uruguay, in South America, also produces a large number of remarkably fine banded agates. Sometimes well-formed quartz-crystals will be found inclosing other substances, which, in some instances, have been caught

up by the crystals in the course of their formation, or have crystallized, perhaps, almost simultaneously with the quartz. In other cases the quartz is proved to have crystallized over other previously-formed crystals; thus schorl is occasionally seen partially inclosed in quartz-crystals and partially free, the ends of the crystals of schorl projecting through the quartz. Titanite, asbestus, and other minerals are not unfrequently found in minute acicular forms in quartz. The quartz in the igneous rocks may frequently be seen to inclose crystals of feldspar or titanite, or portions of the matrix which must have been previously solidified.

Opal, as has already been pointed out, is a product of aqueous origin found in the fissures and amygdaloid cavities of igneous rocks. Its wondrous play of colors has given rise to much discussion by Brewster, Des Cloiseaux, and other writers. Some have attributed it to the presence of numerous cavities of varying size, which cause a kind of iridescent refraction. Des Cloiseaux was inclined to suppose that organic matter might be inclosed in small quantities in its cavities. The most reasonable supposition, however, appears to me to be that of Reusch—that light reflected or transmitted from numberless flaws in the mineral gives rise to the phenomena in question through a process of double refraction.

We may now turn to the consideration of forms of quartz which have a more or less organic origin. At the head of these may be placed such undoubtedly organic aggregations of silica as the Tripoli and semi-opal of Bohemia, which consist almost entirely of fossil diatomaceæ. Some beds of rock also in the Island of Barbadoes are found to be composed of little else than polycystinæ and spiculæ of sponges. Much of the flint so characteristic of the chalk-rocks, as well as the chert of the greensand and of the mountain limestone, appears to have been derived from the precipitation, by organic substances, of silica held in solution by the waters of the ocean; at any rate, much of it seems to have been thus deposited; flinty nodules are often found to consist of fossilized sponges, the silicious skeletons of which may have attracted to themselves the silica dissolved in the surrounding water. Spiculæ of sponges, diatomaceæ, foraminifera, shells, corals, and other organisms are abundant in the flint, and also in much of the chert. Recent observations by MM. Guignet and Teller have shown that the water of the Bay of Rio de Janeiro contains large quantities of both silica and alumina in solution, the amount in the case of silica being as much as 9·5 grains per cubic metre.

Wood will sometimes be found to be pseudomorphosed into silica, the woody structure being replaced atom by atom, so that the minutest vessels are perfectly preserved. Various species of palm from the East Indies are frequently found fossilized in this manner, and sections of them make very beautiful objects for the microscope. Large fragments of a partially silicified wood, named *Endogenites erosa*, may

often be found in the neighborhood of Hastings, derived from the wealden formation.

The curious so-called mineral beekite is really coral or shelly matter which has been replaced by silica. Researches into the behavior of the colloid form of silica, already spoken of, have shown how in many instances large deposits of silica, such as the flinty bands of the cretaceous formation, may have originated. Mr. Church's experiments, made some years since, proved that the minutest particle of carbonate of lime was sufficient to transform the pure aqueous solution of silica into the solid state in the course of a few minutes; and he was able, by the infiltration of silica in solution, to replace almost entirely the carbonate of lime in recent coral by silica, producing by this means what may be looked upon as a kind of artificial beekite. Thus in the slower, perhaps, but mighty chemistry of nature, marvelous reactions may have taken place, giving rise to some of the multitudinous forms in which silica presents itself to the mineralogical student.—*Science-Gossip.*

THE REMEDIES OF NATURE.

By FELIX L. OSWALD, M. D.

CONSUMPTION (*Concluded*).

THE MOUNTAIN-CURE.

CARBONIC acid, the lung-poisoning residuum of respiration and combustion, is heavier than the atmospheric air, and accumulates in low places—in wells, in cellars, in deep, narrow valleys, etc.—and often mingles with the malarious exhalations of low, swampy plains. On very high mountains, on the other hand, the air becomes too rarefied to be breathed with impunity. It accelerates the respiratory process, as the amount of air inhaled at one inspiration does not contain oxygen enough to supply the wants of the organism at the ordinary rate of breathing, and is therefore especially distressing to diseased (wasted) lungs, whose functions are already abnormally quickened, and can not be further stimulated without overstraining their mechanism.

In the temperate zone, the purest and at the same time most respirable air is found at an elevation of about four thousand feet above the level of the sea, an altitude corresponding to the midway terraces of the European Alps and the average summit-regions of our Southern Alleghanies. The broad table-lands of the Cumberland Range are several hundred feet above the dust-* and-mosquito level.

* While the treeless plateaus of the Pacific slope are in a chronic state of sand haziness. In Southern Colorado, too, every high wind shrouds the mountains in whirls of a kind of sand-dust that can be felt under the eyelids and between the teeth.

Between the thirty-fourth and thirty-sixth degrees of north latitude the elevated plateaus have the further advantage that their climate equalizes the contrasts of the season: it mitigates the summer more than it aggravates the winter. Southerly winds predominate, and melt the snow with the same breezes that cool the midsummer weeks, for in the dog days the Mexican table-lands are considerably cooler than our Northern prairie States. In the Alps of North Carolina, Tennessee, and Northern Georgia land and labor are so cheap that even people of moderate means can build a sanitarium of their own. It has been often observed that the moral effect of a residence at a place where consumptives congregate is not favorable to the cure of the disease; and, moreover, a private establishment lessens the danger of contagion. The cheapness of living may be inferred from the fact that at the Chalybeate Springs of Benton, Tennessee, where board-rates vary from fifty to seventy-five cents a day, the visitors from the surrounding country towns, nevertheless, prefer to board on the co-operative plan: the proprietor of a kitchen-garden furnishes vegetables, a stock-farmer fresh meat, the owner of a carriage free transportation, and every family has a little cottage of its own. Summer-guests who come to drink mountain air can build their cabins wherever they find a convenient plateau, and contract with the next farmer for all the comestibles they may need in addition to their canned provisions. They can cook at their own fireplace. A log-house can be made as airy as any tent, and is out and out more comfortable. A rough-hewed porch-roof, projecting like the veranda of a Swiss *chalet*, will keep the cabin both dry and airy; square holes in the center of each wall can serve as windows in fine weather, and during a storm can be shut with a sliding-board. Between May and November the winds in the Southern Alleghanies come from the south or southwest, nine days out of ten, and, in order to get the full benefit of the pure air, the house should face one of the thousand promontories of the southwestern slope that rises in terraces from the "Piedmont counties" of North Carolina and Northern Georgia, with a free horizon toward the plains of the Gulf-coast. Have the door on the south side, and keep it wide open all night, as well as the windows or louvers in the opposite wall. If the windows do not reach to the ground, spread your bedclothes upon a hurdle-bedstead rather than on the floor, in order to enjoy every afflatus of the night-breeze. Night and day one can thus breathe mountain airs that have not been tainted by the touch of earthly things since they left the pine-forests of the Mexican Sierras. Every inspiration is a draught from the fountain-head of the atmospheric stream.

There is no need of living on oiled sardines where the brooks are full of speckled trout. Those who *must* break the commandment of Brahma (and the highland air confers certain immunities), may devour their humble relatives in the form of wild-turkeys, quails, and

opossums ; but the products of the vegetable kingdom are cheap, and diversified enough to make up a tolerable *menu*. Sweet-potatoes at twelve cents a peck, string-beans fifteen, green peas twenty-five ; strawberries ten cents a quart, roasting-ears a cent a piece, brown beans actually a bushel for one dollar—Dalton (Georgia) market-prices. "Semi-annual" comestibles in proportion : eggs eight cents a dozen, butter twenty cents a pound in mid-winter, and ten cents in summer. Milk is a drug in the market ; a good milch-cow can be hired for a dollar a month, a cow-boy for two dollars and his board. Whortleberries are sold at five cents a quart, but the pleasure of picking them is worth a great deal more. The lamest and weakest can join in that sport, for the shrub attains a height of three feet, and thus saves one the trouble of stooping.

About an hour after breakfast the colony (or family) should muster for out-door exercise. The choice between the various opportunities for entertaining work is the only difficulty, for Nature has provided them in embarrassing profusion. Expert bee-hunters can find four or five hive-trees in a single day. The chestnut-forests of the upper ridges are full of squirrels, and with a dog, a sack, and a good axe, it is not difficult to catch one alive, and turn it over to the quartermaster of the pet-department. Climbing trees is an exercise that brings into action nearly every muscle of the human body, and, like the *mal de monte*, the shudder that seizes the traveler at the brink of Alpine precipices, the dizziness that takes away the breath, returns it with interest and is a mechanical asthma-cure. Entomologists may combine the gratification of their mania with useful exercise by rolling logs in quest of big-horn beetles. Log-rolling and tumbling rocks from the tops of projecting cliffs is the spice of life in the engineering enterprises which a campful of male North Americans are sure to set afloat—as enlarging the entrance of a cave, constructing a graded trail to the next spring, to the next wagon-road, or to a favorite lookout point. Enterprises of that sort involve a good deal of grubbing and chopping, but also many interesting discoveries—geological specimens, an unknown chrysalis, new varieties of ferns and mosses. As the work progresses it becomes a pastime rather than a task, and novices feel inclined to agree with engineer Spangenberg, that "with a little management a first-class railroad can be built to any point of the continent earth." There is no cliff that can not be circumvented or terraced. With a slight curve in the road an apparent obstacle can be utilized as a bulwark. In fallen trees the removal of a few side-branches develops revolving faculties. A pickaxe makes a whole wilderness plastic.

The summer air of the highlands makes out-door life a luxury, but the chief advantage of the plan is this : The stimulus of a pleasant pastime enables a man to beguile himself into about ten times as much exercise as he could stand in the Turner-hall. The visitors of a hygi-

enic gymnasium take their turn at the horizontal bar as they would swallow the drugs of a public dispensary: they know that it is a lesser evil, they know that the road to Styx is the alternative, they intend to come every day, but the intolerable tedium of the crank-work exercise soon shakes that resolution. The motive for exertion is too abstract; it lacks the charm of progressiveness and the stimulus of a proximate, tangible, and visible purpose. The sham competition of a regiment of invalids under the command of a *turn-master* does not much sweeten the bitter broth; it is still crank-work, minus the club of the jailer, and nine out of ten hygienic gymnasts will soon find or make a pretext for discontinuing their visits. How many out of a hundred pupils of a young ladies' seminary would dream of performing their "callisthenics" at home? They would as soon walk on all-fours, or ride on a dry clothes-line. But arrange a May-day picnic in the mountains, and they will beat a kid in climbing up the steepest rocks, and swing on wild grape-vines for hours together.

It is likewise certain that fatigues can be far better borne if the body is not encumbered with a surplus of calorific clothes. A pair of linen trousers, a flannel hunting-shirt, and a loose necktie, make the most hygienic summer dress. In the afternoon remove the necktie and roll up the shirt-sleeves: it can do no harm to imbibe fresh air by all available means, and let the cutaneous lungs share in the luxury. Nor is there any excuse for the wide-spread fallacy that it is dangerous, even in the most sweltering nights, to remove the bed-blankets. Kick them into the farthest corner if they become too warm, and sleep in your shirt and drawers, or under a linen bed-sheet. Half-naked lazzaroni sleep the year round on the stone terrace of the Museo Borbonico and outlive the asthmatic burghers in their sweat-box dormitories. The body effects part of its breathing through the pores. Painting a man with yellow ochre and copal-varnish would kill him as surely as hanging him by the neck. The confined air between the skin of the body and a stratum of heavy blankets gets gradually surcharged with carbonic acid—in warm weather even to the verge of the saturation-point. The perspiration is thus forced back upon the body; and the lungs—perhaps already weakened by disease—have to do double work.

Hunters may find it hard to return in time for dinner, and need a rallying-signal. One P. M. is a good time for a general shouting-match. Wake the echoes of the old mountains; the spirits of the departed Cherokees are tolerant—offer a premium for the loudest and ghastliest war-whoop, and depend upon it that no pulmonary disaster will spoil the triumph of the victor. Blood-vessels are not ruptured in that way, but by sudden movements or abrupt ejaculations, when terror or a similar emotion has driven the blood back upon the heart. But, while the mind is at ease, and the lungs not strained by a desperate exertion of the pectoral muscles, I would defy a consumptive to yell himself into a hæmorrhage. A vocal effort does not injure

the respiratory organs; on the contrary, it strengthens them. Statistics show that lecturing and preaching *savants* outlive their graphic colleagues. In Carrollton, near New Orleans, I knew a hectic old Mexican banana-vender who was so short of breath that he had often to clutch the legs of his chair in his dire struggles for life-air, and who told me that every few days or so he had to hitch up his market-wagon, and bawl out his wares at the top of his voice, and for hours together—*in order to ease his lungs.* Intead of speaking in a whisper, consumptives should envy cattle-drivers, whose business gives them a plausible pretext for yelling.

The prejudice against after-dinner speeches is founded upon a more valid reason. Rest, mental and physical, is really a prime condition of a thorough digestion. Invalids, especially, need a liberal *siesta*, and a two hours' nap in the shade of a shelving rock can do no harm. Long, sultry afternoons, though, are unknown in the highlands, and before 3 P. M. the air will again be cool enough for any kind of outdoor sport. If the spring needs cleaning out, a wheelbarrow full of flat rocks from the next creek will turn it into a deep, limpid *brunnen*, where a pail can be filled at a single dip. On sunny days butterfly-hunters may bag their game on every mountain-meadow. Grasshoppers can be flushed by the dozen, and make the best bait for brook-trout. The rock-benches at the water's edge would invite to a prolonged session if other pastimes were not too tempting and numerous. There are raspberries and muscadines in the brake; farther up the woods are strewed with chestnuts, and the collector soon learns to find the little dells where they accumulate, like nuggets in the cavities of a California gold-creek.

It is astonishing how work of that sort makes the hours vanish, together with many evils which tedium is apt to aggravate: languor, spleen, and dull headache. But more wonderful yet is its effect on the disorders of the respiratory organs. Under anything like favorable circumstances the lungs are, indeed, the most *curable* part of the human body. With every inspiration the balm of pure air can be brought into contact with the thousand times thousand air-cells of the respiratory apparatus,* and, as we breathe about twenty times per minute, the panacea can be applied twenty-seven thousand times in twenty-four hours. Every day six hundred and eighty cubic feet of gaseous food circulates through the lungs of a full-grown man, carrying nourishment and restoratives to every fiber and enabling it to rid itself of its morbid excretions. The rapidity of the remedial process has more than once forced upon me the thought, "What persistent outrages against the health laws of Nature must it have required to make the lungs the seat of a chronic disease!"

* "It has been calculated by M. Rouchoux that as many as 17,790 air-cells are grouped around each terminal bronchus, and that their total number amounts to not less than 600,000,000" (Carpenter's "Physiology," p. 507).

The mountain-cure remedies assist Nature only in an indirect way, but before the end of the first week the BREATHING POWER of the asthmatic lungs will revive as seeing and hearing awaken after a trance. The respiration is still short and quick, but becomes less and less laborious; the patient need not gasp for air; his lungs have resumed business, and attend to all the details of its functions till it becomes entirely automatic.

EXPECTORATION becomes less frequent; the source of the affection seems to retreat upward, the *sputa* come from the upper air-passages, and without the preliminaries of a worrying cough. Their quantity gradually diminishes, and the relief is permanent, while cough-medicines loosen the phlegm only by increasing its quantum, and discharging it with a tide of artificial mucus.

The NIGHT-SWEATS, too, soon disappear, for they can be cured on the *similia similibus* principle of the homœopathists—by day-sweats. Put on a flannel shirt, get an old axe and try your luck with a good-sized bee-tree, or with the old log that obstructs the trail. Keep a tin cup about you, and assist Nature by frequent trips to the spring. No matter if you have to change your flannel shirts four times a day; depend upon it that you will not need them at night. The hectic fever abates; the cause has been removed. The sweats as well as the fever are induced by a pulmonary inflammation that increases the temperature of the body, but can be relieved by giving it a chance to eliminate the morbid matter. The four or five quarts of water that were excreted in the process of perspiration have circulated through every pore of the respiratory organs and depurated them more effectively in a single day than the repeated doses of a cough-exciting nostrum could do in a week. After the return from the mountains to the city (not before November, if possible) the occasional recurrence of the trouble will generally be limited to the rainy weeks of the first month, for the antipyretic influence of cold, clear weather rivals that of the perspiration-cure.

The danger of a HÆMORRHAGE is generally passed when the cessation of purulent expectorations proves that the disease has become non-progressive, and that the ulcers begin to cicatrize. *Hemoptysis*, or blood-vomiting, is the only symptom of their disease which is liable to shake the characteristic *hopefulness of consumptives*. It generally frightens them considerably; they are apt to protest against out-door proceedings, and speak with bated breath, under the (erroneous) impression that a vocal effort has somehow induced the trouble. It can do no harm to humor that disposition; but keep the patient on his legs—lying down flat on the back after a heavy hæmorrhage is almost sure to bring on a relapse before the end of twenty-four hours. For the first three or four hours walk slowly up and down, try to keep up a deep and calm respiration, and, if possible, take the first nap in a sitting posture—propped up with cushions and pillows. At the end

of forty-eight hours the danger is past, and out-door exercise may be gradually resumed.

For stubborn DYSPNŒA (want of breath) there is a somewhat heroic but almost infallible palliative, though I own that the *rationale* of its efficacy is somewhat undefined—artificial insomnia. Read or write as long as that will keep you awake; after midnight walk up and down the room for fear of falling asleep in the chair, and toward morning, when drowsiness becomes irresistible, go to bed for a few hours, and that they will be passed in peaceful sleep can generally be inferred from the circumstance that by that time the dyspnœa has disappeared. After the second night's vigils the trouble is not apt to recur for a month or so. But, unless the distress is utterly unbearable, or the necessity for prompt recuperation very urgent, it is, on the whole, better to eschew palliatives and rely on the only permanent asthma-cure—the gradual but normal invigoration of the whole system.

In CHRONIC CATARRH—a frequent concomitant of a tubercular diathesis—the obstruction of the nasal ducts by accumulated mucus yields in a day or two to any exercise that brings into play the muscles of the neck, shoulders, and chest, such as shouldering a good-sized log, walking bolt-upright with two large pails full of water, or a loaded wheelbarrow. A very simple household remedy is a palliative to the same effect: hot water applied to the palms of the hands and the soles of the feet. It affords immediate though often only temporary relief; for the diathermal influence of the hot-water treatment, as it were, dries up, and thus temporarily reduces the mucous accumulations, while the preferable exercise-cure more gradually but permanently removes the cause of the trouble.

The stitch-like PAIN IN THE CHEST is apt to recur with every catarrh, and forms, indeed, only an incidental concomitant of tubercular consumption. It is a pleuritic affection, and is often entirely wanting in cases that end with death by tubercular cachexia. The Calmuck Tartars, who defile the air of their family tents with tobacco-smoke and suffer the usual consequences, cure pleuritic inflammation by a simple method of inunction: viz., by fomenting the nape and chest with hot mutton-tallow. When loss of appetite indicates a derangement of the digestive organs, ointments may be used as a temporary substitute for a demulcent diet.

Dropsical swellings, chronic diarrhœa, with frequent chills, prove that the disease has reached the colliquative or hopeless stage of its development. But, even under such circumstances, the mountain-cure, in the form of moderate exercise in the pure air of a highland sanitarium, will confer at least the negative benefit of saving the patient from the horrors preceding the last act of a hospital-tragedy—it will insure an anæsthetic conclusion of the disease; the vital strength will ebb away in a painless *deliquium*.

But while the vital forces still keep the foe at bay, i. e., before the

symptoms of the decline have assumed the chronic form, before the process of digestion becomes utterly deranged, before the impoverishment of the blood results in dropsy and a livid discoloration of the lips, while the patient has intervals of sound sleep and sound appetite, and strength enough left to walk a couple of miles—there is more than an even chance that the disease can be permanently cured. One memento only of its ravages will remain—the acceleration of the breathing-process whenever the convalescent engages in active exercise. But even that inconvenience can be diminished by a system of training that will gradually inure the lungs to the strain of the ordinary movements and exertions of daily life: namely, by walking up-hill (or upstairs) with a load of daily increasing weight. After two months or so it will take two scuttles full of coal to produce the panting and gasping which used to result from a small pailful of water, and the mere weight of the body will seem barely sufficient to indicate the difference between a rough mountain-trail and a graded pike-road.

A few years ago an emaciated Canadian miner came South for his health, and located a small placer-claim on the plateau of the "Fort Mountain," in Murray County, Georgia. The mountain is a mile high, and the up-trip with a few dozen eggs from the next valley farm obliged the miner to stop every few minutes to keep his chest from bursting, but before the end of the year he was able to make the same trip, without a stop, with a bushel-bag full of corn-meal. The waste from the corrosions of the tubercle-virus can perhaps never be repaired, but the healthy tissue of the remaining portion of the lung is susceptible both of expansion and invigoration. The lungs expand and contract with the chest. If three sisters marry on the same day—the first a ferryman, and learns to row a boat; the second a tailor, and takes to tight-lacing; the third a grocer, and tends his shop—an autopsy would show that in twenty years after their separation the ferrywoman's lungs have grown fifty per cent larger than the shopkeeper's, and fully twice as large as the dressmaker's.

But few consumptives ever outgrow the sensitiveness of their lungs, and must beware of contagion, avoid crowded meetings and lectures, and rather offend Mrs. Grundy than prolong their visits to a catarrh-infected house. Thoroughly healed though reduced lungs (reduced often to two thirds of their original size) will perform their functions in a sufficient manner for a long series of years. With the above-named precautions and a nutritive but strictly non-stimulating diet, there is no reason why a convalescent from pulmonary scrofula in its most unmistakable form should not enjoy an out-door festival in honor of his eightieth birthday. It is well known that in the *deliquium* of pulmonary consumption, in the stage of violent hæmorrhages and dropsical swellings, the confidence of the patient often gives way to gloomy forebodings—the harbingers of the long night that never fails to cast its shadows before. But this despondency

is not more significant than the hopefulness that precedes it. For I believe that instinct is right in both cases, and that in the first stages of its development consumption is really the most curable of all chronic diseases. Chateaubriand, Heinrich Voss, Count Stolberg, Alfieri, Francis Deak, and Dr. Zimmermann, were descended from consumptive parents, but redeemed their constitutions by traveling and out-door exercise, and attained to a more than average longevity. Goethe, in his younger years, was subject to hectic fevers, with frequent hæmorrhages, but recovered and died as an octogenarian.

A tendency to emaciation, the most characteristic symptom of tuberculosis, generally continues to counteract the normal effects of a liberal diet, even combined with continence and a tranquil mode of life; but the limitation of that tendency is a sufficient guarantee that the disease has become non-progressive. But there is a still surer criterion: consumptives are generally remarkably fair and smooth skinned. The reason is, that the dross of the cachectic system gravitates toward the diseased lungs. An East-Indian surgeon found that small-pox can be localized by rubbing the chest with croton-oil, and thus concentrating the eruption. Pulmonary consumption is a kind of centralized scrofula. Two hundred years ago, when the cutaneous form of the disease was more frequent, surgery was often invoked to remove ulcers that threatened to disfigure the patient or destroy his eyesight. The approved method was to produce an artificial and larger sore, where it could not do so much harm, on the arm, below the chin, or on the nape of the neck. The larger sore attracted the morbific matter; and thus healed the smaller one. For cognate reasons, a scrofulous affection of the respiratory organs acts, as it were, as a *cosmetic*. Pimples disappear; boils head at once, and without suppuration; intemperance, surfeits, a congenital taint of scrofula, do not affect the color of the face; and (excepting the effect of gross dietetic abuses, which ultimately react on the lungs) the cutaneous excretion of such impurities is therefore not an unfavorable symptom. For their reappearance on the surface of the body proves that the respiratory organs have ceased to attract the cachectic humors of the system; in other words, that the tubercle-sores have cicatrized, and the lung-destroying virus has been eradicated.

A GERMAN VIEW OF THE "DATA OF ETHICS."*

By FRIEDRICH VON BAERENBACH.

PHILOSOPHICAL thought is tending more and more toward concentrating itself upon problems of physiological as distinguished from metaphysical psychology, and to the inquiry after those facts which can be ascertained. The best workers in this field are still

* Translated and abridged for "The Popular Science Monthly" by Thomas Cross.

troubled, nevertheless, lest they may lose the connection with the sciences, and particularly with that special research and exact calculation under the influence of which a happy reaction has made itself felt in the various departments of philosophy against the intuitive and undisciplined ways of thinking that have characterized many metaphysicians.

As in life all gives place to the question of the highest utility, so in science all gives place to pure theoretical interest in enriching our knowledge of facts. But, while this may find its justification in the history of culture, the problems of the work of culture are no more exhausted thereby than the problems of thought. Philosophy would surrender her most important function were she to shirk the solution of those problems which she alone can solve. To these problems belong, last not least, those of ethics.

The progress of scientific knowledge in all domains of inquiry is the mightiest instrument in aid of the progress of culture. Its influence reaches, directly or indirectly, to all human relations, not excepting moral development. Apparent contradictions diminish or disappear before the macroscopic glance, which, not fixed upon any isolated point, takes in the whole range of facts and causes in their mutual relations. We are at the same time convinced, even by the consideration of the educational influence which scientific efforts have acquired in all strata of modern society, that all is not done. The gap is visible and sensible in philosophy and in life.

The needs of a great community of thinking men neither seek nor find any satisfaction in the dogmas of a positive confession of faith, while, for the foundation of a system of practical regulative laws and ethical principles, the progress of inductive science does not furnish all that is needed. A bridge is wanted, which shall establish connection with active life; a well-spring of right, from which laws and principles can be drawn and distributed.

According to some philosophers, ethics stands or falls with metaphysics. That this is not the case has been proved by the isolated achievements in moral philosophy of the disciples of modern positivism, and is demonstrated afresh by Herbert Spencer in his "Data of Ethics." This author occupies so conspicuous a position among the philosophic writers of the century, that the summons to a study of his works may well find ample response.

We may gather, from the preface to his last work, how Herbert Spencer, like other founders of great philosophic systems, esteems the importance of ethics. "This last part of the task it is to which I regard all the preceding parts as subsidiary." From the beginning of his philosophical activity this was the "last goal," the object to which all efforts were preparatory—to find a scientific basis for the principles of good and bad in action.

"Now that moral injunctions are losing the authority given by

their supposed sacred origin, the secularization of morals is becoming imperative. Few things can happen more disastrous than the decay and death of a regulative system no longer fit, before another and better regulative system has grown up to replace it." For this reason, Herbert Spencer has sought to fill the gap caused by the disappearance of the code of supernatural ethics, by a code of natural ethics.

The vacuum is before us, while some consider the filling of it superfluous and others impossible. Herbert Spencer believes that it can and must be filled. High above all problems of cultural and scientific endeavor he places that of the foundation of scientific ethics.

It is presumed, in the conception of ethics, that it shall establish the "ought." Unlike other moral systems, scientific ethics deals with the establishment of the practicable "ought"; not with duties *in abstracto*, but with duties which can be performed. For, "by association with rules which can not be obeyed, rules that can be obeyed lose their authority." Here the critical point of view is established whence scientific ethics must prove the conclusions of moral philosophers upon their merits.

Throughout the "Synthetic Philosophy," which will be closed by the "Principles of Ethics," of which the "Data of Ethics" forms the first part, the fundamental principles of modern evolution are enlisted for the solution of biological, sociological, and psychological questions, to such an extent that this philosophy may be described as a distinct branch of the philosophy of evolution. No system of natural philosophy has, with equal consecutiveness and completeness, adapted the achievements and the hypotheses of modern natural science to the construction of a philosophy on a scientific foundation.

Herbert Spencer's "First Principles" serve as an introduction to this philosophy, and define the stand-point from which the author surveys the whole range of philosophical inquiry. This work undertakes the experiment of a universal application of the fundamental laws and hypotheses of natural science, at the same time generalizing the principle of evolution, and making it the one great underlying principle. It takes up the work of critical philosophy, defining the limits of the knowable and the unknowable. It attempts the only possible reconciliation between religion and science, by pointing to their common, final resting-place in the absolute. The works included in the "Synthetic Philosophy" form parts of a great system held together by the principle of evolution; displaying stupendous learning, and a rare universality of scientific culture, entitling their author to a place, *mutatis mutandis*, beside Aristotle himself. These comprehensive writings afford, even to those who can not accept their underlying principles, a plenitude of instruction.

As to the statement of the problem in general form, serious difference of opinion is hardly possible. For every school and from every stand-point, ethics is a regulative discipline; not laws of the actual,

but laws of the "ought"; not laws of conduct in general, but of conduct of a certain kind. As logic establishes the regulative laws and postulates of scientific knowledge, ethics establishes the regulative principles of moral life.

The stand-point assumed by the author, in dealing with evolution, serves also in ethics. It appears to him evident that, from indifferent actions to actions which are good or bad, the transition is quite gradual. In ethics, as in evolution, the higher development must be explained by the lower. The study of ethical problems presupposes the study of human action as a whole, and this again presupposes that of the actions of living beings in general. The study of the evolution of action forms the preparation for ethics.

It is shown, in the first place, that "higher organic development is accompanied by more highly developed action." The latter is "an improving adjustment of actions to ends, such as furthers the prolongation of life, such as furthers an increased amount of life." Action adapts itself more and more to self and race maintenance; and here also the general evolutionary principle is applicable. "Race-maintaining conduct, like self-maintaining conduct, arises gradually out of that which can not be called conduct; adjusted actions are preceded by unadjusted ones."

In treating of good and bad conduct, Herbert Spencer, in the first place, endeavors to establish the meaning of the terms "good" and "bad." Actions properly adapted to ends are good, and actions not so adapted are evil, both these definitions being taken in a relative sense only. Good conduct is identical with the most highly developed conduct, which "simultaneously achieves the greatest totality of life in self, in offspring, and in our fellow-men."

Pessimistic verdicts upon the value of life are combated by the author with all the might of his intellect, as standing in harsh contradiction to every paragraph of the unwritten moral code of humanity. He leans toward a limited optimism. He rightly urges that pessimists and optimists agree on one point. Both "assume it to be self-evident that life is good or bad according as it does, or does not, bring a surplus of agreeable feeling. . . . Each makes the kind of sentiency which accompanies life the test."

A general consideration of the conflicting views of life brings the author to the conclusion that the good, on the whole, is that which causes pleasure; that our ideas of good and evil arise from the certainty or probability that the same will call forth, somewhere or some time, pleasure or suffering.

Not man as an individual, independent of social relations, of family, people, state, society; not man or humanity in the abstract; but man in society, the social individual, the member of the social union, is the subject for whose moral action, for the adaptations of whose conduct to the highest aims of social life, it is the business of scientific ethics

to establish normal principles. It was, therefore, necessary to loosen the bonds which had bound ethics to unscientific propositions and dogmas of traditional transcendentalism, and to establish its scientific character by a union with the foundations of our scientific knowledge. This, in brief, is the programme for the reform of ethics, or, rather, for its establishment on a new basis. The unscientific methods employed by ethical writers are sharply criticised; the logical propositions upon which the foundation of scientific ethics depends are clearly stated; and the false premises exposed which render all scientific procedure impossible.

In the exposition of the relativity of suffering and enjoyment, and in the sections on "Egoism *versus* Altruism" and "Altruism *versus* Egoism," the author grapples with the fundamental problems of anthropological ethics. The priority of egoism is convincingly set forth, the spontaneous origin of pure altruism, and the interdependence and complementary relations of both principles; while the one-sided assertions and demands of their respective champions are refuted. The final reconciliation of egoism and altruism is inferred from evolution, from which the author also reaches that conciliatory and compromising position which enables him to reconcile many seemingly contradictory phenomena.

Evolutionary morals are wholly hedonistic. The happiness-giving is the good; and it is owing to theological and political influences alone that mankind overlook this truth. The idea and the desire of happiness, of perfect well-being, necessarily mark the character of good conduct. Moral life is a series of compromises between egoism and altruism. All other moral principles derive their conditional justification from this first principle of human action, which is characterized by Kant as the negation of all morality. The idea of perfectibility is tried by the same standard, and we are reminded that capacity for the reception of happiness is the highest proof of the perfectibility of human nature. Aristotle, who recognized happiness as the highest aim of human endeavor, took a step out of his way when he "sought to define happiness by the aid of the word 'virtue,' instead of defining virtue by the aid of the word 'happiness.'" Hence it must be conceded that "the conception of virtue can not be separated from the conception of happiness-producing conduct; and that, as this holds of all the virtues, however otherwise unlike, it is from their conduciveness to happiness that they come to be classed as virtues."

The welfare of society as a whole is regarded as the first problem, but not as the final object, being preparatory to the furthering of individual life and welfare, which is to be compassed by the fostering of social interests. The subjection of personal to social welfare is regarded as a temporary consequence of the existence of antagonistic societies; and, when the social aggregate, arrived at a certain elevation of development, shall no longer be in danger, the welfare

of individuals will be the object. Individual happiness has the last word.

In the "System of Synthetic Philosophy," evolution is the universal world-law, the law of laws, dispensing with all need of stern commandments of revealed religion and theological morality. The evolution of human nature and society brings with itself this, that human conduct becomes better and better adapted to individual and social aims; that good conduct (adapted to the preservation of the race) gradually overpowers bad conduct (unadapted to self and race maintenance) in that struggle for existence in which morality and virtue have on their side every advantage. As the fitter organism survives the less fit, so must moral conduct in the natural course of things gain the upper hand, and immoral conduct tend more and more toward extinction. Thus, according to immutable laws, higher forms of conduct must be evolved from the original conduct of man in his lower estate, as higher organisms are evolved from lower. Changes such as have taken place in the course of civilization will take place again. The want of faith in a further like development, whereby man's nature will be brought into harmony with his condition, is only one of the innumerable proofs of an inadequate knowledge of causality; and he who has learned to put aside primitive dogmas and primitive ways of looking at things, and who has appropriated those modes of thought which science produces, can not believe that the "wholesome working Force" which has hitherto so changed all forms of life according to the altered requirements of their being, will not continue to operate in the same direction.

Ethical evolution affords an imposing outlook for the future of mankind. Man does not waver, like Hercules, between virtue and happiness. He is spared all pain of choice. Virtue and happiness are the one inseparable goal which he approaches with steady advance. Nature herself leads him on, and he has in his own nature the assurance of victory. Ceaselessly bent upon his own advancement, restlessly at work improving the conditions of his existence, he at the same time nourishes his moral life. No moral law opposes the impulses to this advance. No antinomy between moral and natural law needs solution, no strife between moral and sensual impulses need be decided. Always and everywhere an aspiration, a goal. No subjection of the *ego* to a law which commands without regard to weal or woe, no sacrifice of individual claims, no giving up of self at the bidding of an absolute moral law. Development is never interrupted. In ceaseless progress it approaches the goal—the greatest sum of well-being. The rigoristic "Thou canst, for thou oughtst," has no place here. Guidance is enough, compulsion is not needed.

This ethics is confessedly utilitarian, before all things a higher form of utilitarianism; but no raw materialist philosophy of usefulness, addressing itself to brutal egoism, to sensual enjoyment, to the

worship of material wealth, to the thirst for riches and power at the expense of others. Whatever furthers development and brings its goal nearer, is useful; and the goal of development lies in a fair and distant future, whose outline the philosopher thinks he sees. The highest aim, to which all others are subsidiary, to which the strivings of the best are directed, is a moral order of life corresponding to the noblest longings of reason, of the most highly developed man in the most highly developed society. Such a system appeals to that ennobled and enlightened utilitarianism which constitutes the longing after ideal possessions—the condition of the highest welfare of man.

The rigorism of other moral systems has no place in the ethics of evolution. Its moral law is not like that of Kant, sublimely above all connection with natural impulses and inclinations, nor does it constitute moral life a continuous battle against desires which aim at the furthering of individual happiness. "Great mischief has been done by the repellent aspect habitually given to moral rule by its expositors, and immense benefits are to be anticipated from presenting moral rule under that attractive aspect which it has when undistorted by superstition and asceticism. If a father, sternly enforcing numerous commands, some needful and some needless, adds to his severe control a behavior wholly unsympathetic; if his children have to take their pleasure by stealth, or, when timidly looking up from their play, ever meet a cold glance, or more frequently a frown—his government will inevitably be disliked, if not hated; and the aim will be to evade it as much as possible. Contrariwise, a father who, equally firm in maintaining restraints needful for the well-being of his children or the well-being of other persons, not only avoids needless restraints, but, giving his sanction to all legitimate gratifications and providing the means for them, looks on at their gambols with an approving smile, can scarcely fail to gain an influence which, no less efficient for the time being, will also be permanently efficient. The controls of two such fathers symbolize the controls of morality as it is and morality as it should be."

This comparison, however, does not hold good of all forms of rigorism. Kant's moral law knows neither inclination nor disinclination. It neither attracts by rewards nor terrifies by punishments. It is neither the father who adds unsympathetic bearing to stern supervision, nor the father who helps the enjoyment of his children and watches their games. It is sublime above all traffic with the inclinations. And it may still be asked whether Kant was "so far from the track of truth" when he sought the ethical criterion in the law-abiding, duty-abiding sentiment, and maintained the supremacy of that sentiment with that enthusiasm which inspired his famous apostrophe to duty: "Duty, thou sublime, thou lofty name; which embracest within thee naught beloved bringing flattery; commanding submission, though threatening nothing to move the will, but only setting up a

law which of itself finds entry into the breast, and wins for itself unwilling reverence, if not always obedience; before which all desires are dumb, even should they work against it in secret. What origin is worthy of thee, and where shall I seek the roots of thy noble descent, which proudly spurns all kinship with the desires?"

But, if we accept the system of Herbert Spencer, the rigoristic conception of Kant appears superfluous and even injurious. The doctrine of natural development affords a glimpse of the promised land, of a future wherein virtue and happiness will mean the same thing, wherein no antagonism will be conceivable between duty and inclination. No ethics can cheer us to unresting strife by a nobler goal, none can hold out a sublimer prospect. A beautiful faith is that in the upward movement of humanity. It renders easy the battles, the dangers, the countless sacrifices, which lie in the way.

But, notwithstanding the merits of the work under consideration, in certain principal utterances, and in its distinguished contributions to relative ethics, the fundamental principle of absolute ethics, the ethical criterion of action, appears to belong as yet to the number of those problems most needing solution. The last word is not yet spoken; but the results placed in our possession so far, justify the assumption that the evolutionary system of Herbert Spencer will materially assist the thorough reform of ethics, by its critical and positive preparatory work.

COST OF LIFE.

By JOHN PRATT.

NOTHING so forcibly strikes the attentive observer of natural phenomena as the prodigal expenditure of force and matter—the immense over-supply of seed; the enormous waste of sun-force in irrigation; the incalculable power, never to be utilized, represented in tidal action, and in atmospheric, oceanic, and river currents. If we extend our observation to the solar system and the inconceivable spaces intervening between that and the neighboring systems, the imagination fails to grasp the relation between the force that is utilized and that which is wasted. A million carried to the tenth power as a multiple, would fail to represent the waste of natural forces, as compared with the rudest Newcomen pumping-engine of the earliest type. This is familiar science, yet the expansion of the idea may present some points of novelty.

It is obvious that the whole system of planets, representing so many minute points in space, receive only an almost infinitesimally small proportion of the light and heat evolved by the sun. Some physicists are fond of giving the exact figures, but this is presenting

the inconceivable. Siemens has made a very unsatisfactory effort to show that the force is conserved. He has made but few converts to his theory. It is the purpose of this monograph merely to expand the received idea of waste, by showing that the recipients of the prodigal bounty of the great giver of all good in our solar system—the sun—are far fewer than is usually supposed.

Before the spectroscope taught us that the reign of chemism is co-extensive with that of physics, many conjectures were indulged in by astronomers as to the inhabitability of the planets in general. It was taken for granted that there was probably an endless variety in the forms, composition, and even original substance of matter. Vegetation and animalism probably assumed wonderful shapes, and were capable of existing amid conditions not only altogether different from the terrestrial, but altogether incompatible with life on this earth. This conception, unphilosophical *a priori*, and indirectly the fruit of the wonder-instinct and that bias inherited, according to Comte, from the theological *régime*, has been swept away, and the reign of law extended to the mystic dream-lands of the universe. No thinker so loosely hinged now as to imagine life without a certain degree of heat, light, and without oxygen, hydrogen, carbon, and all the chemical elements, and that too in protean forms. Nay, more, the forms and succession of life must be, wherever found, substantially such as we are familiar with. If Venus has human inhabitants, they are not one-eyed Cyclops, nor does vegetation bury its leaves in the ground and spread its roots in the air. Organs, and functions, and instinct are there also, subject to the grand laws of selection and development. Further, the absence of conditions essential to the sustenance of life on our globe would be equally fatal in any other. This brings up the question in hand—the scarcity, as a part of the problem of the cost, of life.

What planets are inhabited? Let us begin with the giant worlds on the verge of the system. In the first place, as might have been conjectured even before the revelations of the spectroscope, from their great volume of light as compared with their distances from the sun, all of these great bodies are self-luminous. They are at least incandescent, and doubtless Jupiter and Saturn are in a fluid, perhaps gaseous state. There can not be the slightest doubt that they are no more fit for life than the sun itself. Will they ever become the habitations of living things? Ignoring their distance from the sun, which to an inhabitant of Saturn would have about the apparent magnitude that Jupiter has to us, there are other considerations which set that question at rest.

The volume of Jupiter, for example, is about 1,280, Saturn 991, Uranus 80, times that of the Earth. The density of Jupiter being about 1·40 and that of the Earth 5·48, it follows that the attraction exerted by Jupiter is, roughly, 300 times that of the Earth. A man

who weighs 150 pounds on the Earth, if transported to Jupiter, would shake the ground with a ponderous tread of 45,000 pounds, or 22½ tons! His own weight would at once crush him into a mere pulp. A hickory-nut, falling from a bough, would crash through him like a Minié-ball. Again, water would weigh fifteen times as much as quicksilver. A moderate wave would shiver to atoms the strongest iron-clad, a rivulet would quickly form cañons miles deep, and ordinary hailstones would destroy every living thing. If we suppose the existence of an atmosphere, even no more profound than our own, its weight would be a third that of water, and its pressure 4,500 pounds to the square inch—sufficient to crush a rhinoceros or the boiler of a steam-engine. In motion, as a moderate breeze, it would sweep away not only every work of man, but the very hills and mountains. The same condition, in less degree, may be predicated of the lesser of the giant planets, and Jupiter is only selected as the most striking example.

Putting aside the hundreds of known, and the thousands and millions of unknown asteroids, as obviously unfit for life, let us next consider the case of Mars. The relative mass of Mars being only about $\frac{1}{10}$ that of the Earth, it follows, as a necessary consequence of the laws of gravitation, that our typical man would only weigh about 2½ pounds on the surface of that planet. Individual locomotion would be wonderfully facilitated, but its conditions would be reversed. The familiar dream of flying by a mere upward movement of the limbs might easily be realized in Mars, but an 80-ton locomotive would not propel a train of empty cars, and mechanical work of all kinds would be practically impossible. Niagara Falls, in such a planet, with water approximating the weight of air, would scarcely furnish power for a mill. A rifle-ball might be caught in the hand without harm. It is obvious that, with an atmosphere of the density of our own, animal and vegetable life, and every artificial work, representing so many structures of gossamer, would disappear like magic at the first breeze. But no such atmosphere as ours is possible with Mars. Even supposing it to equal our own in altitude, its pressure would be only about one fourth of a pound to the inch. Life is impossible in such an atmosphere, as is shown by a far less tenuity at the summits of lofty mountains. But, even if gravitation were not deficient, the distance of Mars from the sun entitles him to considerably less than half our supply of light and heat; a disadvantage immensely aggravated by his very eccentric orbit. Croll has shown how the shifting eccentricity of the earth's orbit, by adding three weeks to the duration of winter, brought about the glacial epochs, and covered nearly the whole earth with ice at various eras. Conceive, then, the thermometer in the Martial torrid regions touching 50°, and that even under the hypothesis, rendered impossible by the very laws of gravitation, of an atmosphere as dense as our own! Nothing can be more certain than that there is no liquid in Mars, and no life.

The same set of conditions, in exaggerated degree, exist in the minor superior planets, Ceres, Pallas, Juno, etc., while the asteroids are as much out of the question as the comets and meteors. In regard to the Jovian and Saturnian satellites, only probable conjecture can be indulged. We do not know with sufficient accuracy the degree of heat and light received from their primaries, to judge of those conditions, but all the obstacles flowing out of deficient gravitation predicated of Mars exist in equal degree in these satellites, the largest of which is inferior to Mars in dimensions.

In regard to our own moon much more definite information is accessible, though little need be said of its present life-conditions. Its bi-monthly axial revolution, its long, more than torrid day and antarctic night render it unnecessary to consider the question. But the mass of this satellite being about a third less than even that of Mars, interposes, and has ever interposed, the same everlasting mechanical obstacles to life there as in Mars. Atmosphere the moon may once have possessed, but it must always have been insufficient for life, insufficient to secure the stability of water, which, even if it continued in a liquid condition, would be swept—so light was it—in vast tides over the highest mountains. For the rest, if there be a man in the moon, it is interesting to know that he weighs less than two pounds, and can jump a mile, more or less.

Mercury, with a temperature of boiling water in the frigid zones and red-hot iron at the equator, may be a good place for a Calvinist to send his wicked neighbor, in imagination, but it can not be placed among the list of inhabited worlds. At last, then, out of all the vast, the countless myriads of circling orbs that do homage to our sun, only two remain to be considered—the Earth and Venus.

Venus, although too near the sun to render it likely that her tropical regions are habitable by man, is, so far as can be judged from her general physical condition, by no means destitute of life. If there be truth in the nebular hypothesis, Venus is younger than the Earth, and is therefore perhaps not evolutionized as to the highest forms. As to this, speculation would be little better than conjecture. Enough, that of Venus it can not be said, as of the other planets, with a certitude derived from the exact sciences, that there is no life in her.

The insignificant little globe called the Earth furnishes the only assurance of the higher forms of life, and, with the one exception of a globe even less than ours, of life in any stage of evolution. The Earth is not the millionth part of the known matter of our system, and, compared with the space occupied by that system, is far more insignificant than the smallest fleck of foam in the ocean. This tiny island in space does indeed teem with life; but, if this life were distributed equally through the space given to its production, thousands of miles would intervene between every individual form.

So much for the space and energy expended in the evolution of

vitality. The same immense expenditure, the same apparent disproportion discloses itself when we consider the time that has been consumed in the process. Here we are again confronted by figures approximating eternity. Life has existed on the Earth millions of years, and mammalian life hundreds of thousands of years. Yet such periods are insignificant in comparison with the cosmogony of the planets. The duration of the highest order of life, under the refined conditions of a high type of civilization, is but of yesterday comparatively, but it has taken so enormous a period to ripen that we can no more conceive of it than of eternity. A space so vast that it is a tedious journey for light to traverse, and a lapse of time so great that a snail might have made the circuit with ease in the morning of it, have been necessary to give birth to one Shakespeare! All this space, and all this time, and all this immortal energy have as yet barely sufficed to develop a few organisms capable of a glimmering comprehension of the forces which have evolved them. All the rest, if the accepted theories of gravitation and light and heat are not wholly illusory or misunderstood, is waste space, waste matter, waste energy. Life is far more rare and far more costly in our solar system than diamonds in the earth.

But why not? Space is boundless, matter is infinite in quantity, and time is limitless, past and to come. Where the treasure is exhaustless, the question of cost is only interesting from a speculative point of view. This as regards the past.

One of the elements of cost—time—has an interesting bearing on the future of the universe. Some scientists have of late indulged in presages more despondent than philosophical. According to this school, the dissipation of energy into space will finally result in the death of matter. Matter, being indestructible, will exist forever, but its soul will perish; first the vital form, then electricity, light, and heat, and finally even atomic vibration—leaving all cosmic bodies mere cadavers, like the terrestrial moon. This view has been combated by special theories, like that of Siemens, but not with great success. But there is a large aspect of the question which, though it seems to have escaped the attention of thinkers, at once sets it at rest, and demonstrates that energy and life are immortal. Bacon says of eternal duration, that, dividing it into past and future, it is of no consequence where we draw the line; a billion years ago, or a billion years hence, or the present, the two parts are still equal to each other and to the whole; thus contradicting all the laws of quantity. If this be a paradox, it has the peculiarity of being irrefutable, since it is impossible to conceive of any greater eternity than either the past or the future. Assuredly it can not be maintained that the future eternity is greater than the past. Assuming, then, this postulate, and that energy in all phases has been eternal in the past, it follows, with a force that commands unhesitating assent, that it will be eternal in the future. Whatever is, has been; whatever will be, has been. En-

ergy has had one eternity in which to dissipate itself. What one eternity has not sufficed to bring about, will never be consummated. It may be interesting, but it is not essential to the demonstration, to investigate the method by which energy dissipated becomes once more potential. Perhaps the most tenable theory is, that it will be accomplished by the collision of dead worlds with each other, and the resulting mechanical evolution of light and heat. According to this view, attraction is the grand reservoir of the generic energy of the universe, on which all matter may draw when its differentiated force has been dissipated. But, be this as it may, the fruitful union of matter and energy in the infinite past is a stable guarantee that they will never be divorced.

ON SCIENCE-TEACHING IN THE PUBLIC SCHOOLS.*

THE repeated appointment, by this body, in successive years, of committees to look into the scientific education of the public schools, must be taken as showing that such an inquiry is regarded as both legitimate and important. Yet the duties of such a committee have not been defined by the Association, nor have any of our predecessors opened the way to a consideration of the subject. It was probably expected that we would furnish a digest of information from many quarters, as to what sciences are taught in the public schools, with what facilities, and to what extent; accompanied by such recommendations regarding the increase of scientific studies as the results might suggest. But our course has not proved to be so clear. We have been arrested at the outset by a question of the quality of the science-teaching in these schools which demands the first consideration. There are certain radical deficiencies in current science-teaching, the nature and extent of which must be understood before any measures of practical improvement can be intelligently taken up. We shall here confine ourselves to this preliminary inquiry.

The investigation has interest from the immense extent and rapidly increasing influence of the American public schools. There are now nearly a hundred and fifty thousand of these schools, supported at an annual expense of probably seventy or eighty million dollars. Maintained by State authority, they are firmly established in the respect and confidence of the community. Under the influence of normal schools, teachers' institutes, systematic superintendence, school boards, regulative legislation, and an extensive literature devoted spe-

* Preliminary report of the committee, appointed at the Saratoga meeting of the American Association for the Advancement of Science, on "Science-Teaching in the Public Schools," read at the Boston meeting, in August, 1880, and published in the "Transactions" of the Association.

cially to education, they have become organized into a system which is gradually growing settled and unified in its methods. With unbounded means and unlimited authority, these schools have undertaken to form the mental habits of the great mass of the youth of this country. They prescribe the subjects of study, the modes of study, and the extent and duration of studies for all the pupils that come under their charge. The sphere of their operations is, moreover, steadily extending. They are everywhere encroaching upon the province of higher education, everywhere trenching upon private schools, and diminishing the interest in home education.

It may be assumed that the time has fully come when this system must be measured by the standards of science, and approved or condemned by the degree of its conformity to what these standards require. Science has become in modern times the great agency of human amelioration, the triumphs of which are seen on every hand and felt in all experience. Grave subjects are brought successively under its renovating and reconstructive influence; and latest and most important among them is the subject of education. Our inquiry now is how far the public-school system has availed itself of the valuable aid that science offers in the proper cultivation of the minds of the young.

The interest and necessity of such an investigation will hardly be denied; but there may be a query as to its relevancy to the appropriate work of this society. The making of science popular was not among the objects for which our Association was formed. Not that its founders were unmindful of the importance of widely diffusing the results of research; but they recognized that the interests of science are so vast as to be only efficiently promoted by division of labor. Under the operation of this principle it was made the distinctive purpose of the Association to contribute to the extension of original science by the discovery of new scientific truth, leaving its dissemination to the schools, the press, and the various agencies of public enlightenment. Nor does your committee understand that it is now proposed to depart from this policy; for the inquiry before us is really most pertinent to our special objects. It certainly can not be a matter of indifference to this body, from its own point of view, how science is dealt with in the great system of schools which has undertaken the task of molding the youthful mind of the country. We aim to advance science by the promotion of original investigation, which depends upon men prepared for the work. Do the schools of the nation, by their modes of scientific study, favor or hinder this object? Do they foster the early mental tendencies that lead to original thought; or do they thwart and repress them? We have an undoubted concern in this matter, and it is, moreover, strictly identical with that of the community at large; for there can be no better test than this of the real character of the school system. When we ask whether a mode

of teaching and a manner of study are calculated to awaken the spirit of inquiry, to cultivate the habit of investigation, and rouse independdent thought, our question goes to the root of all true education.

All sciences are the products of a method of thinking, and it is that method which concerns us when we propose to regard it as a means of mental cultivation. Science is an outgrowth of common knowledge, and the scientific method is but a development of the ordinary processes of thought that are employed by everybody. The common knowledge of people is imperfect because their observations are vague and loose, their reasoning hasty and careless, their minds warped by prejudice and deadened by credulity, and because they find it easier to invent fanciful explanations of things than to discover the real ones. For thousands of years the knowledge of nature was rude and stationary because the habits of thought were so defective. But, with a growing desire to understand how the world around is constituted, men improved their processes of thinking. They began, and were compelled to begin, by questioning accepted facts, and doubting current theories. The first step was one of self-assertion, implying that degree of mental independence which led men to think for themselves. They learned to make their own observations and to trust them against authority. It was found, as a first and indispensable condition of gaining clear ideas, that the mind must be occupied directly with the subject to be investigated. In this way scientific inquiry at length grew into a method of forming judgments which was characterized by the most vigilant and disciplined precautions against error. Of the mental processes involved in research it is unnecessary here to speak; we are only concerned to know that the scientific method is simply a systematic exercise in truth-seeking, and is the only mode of using the human mind when it is desired to attain the most accurate and perfect form of knowledge. The whole body of modern scientific truth, disclosing the order of Nature and guiding the development of civilization, must be taken as an attestation of the validity of the scientific method of thought by which these results have been established. We here get rid of all cramping limitations. The scientific method is applicable to all subjects whatever that involve constancy of relations, causes and effects, and conform to the operation of law. It is applicable wherever evidence is to be weighed, error got rid of, facts determined, and principles established. Our public schools, unhappily, make but little use of this method in the work of mental cultivation, and we shall find some explanation of this by referring to the way they grew up.

The American public-school system originated in the theory that the State owes to every child the rudiments of a common education, or an elementary knowledge of reading, writing, and arithmetic, as implements of after mental improvement. But it was early found difficult to separate this primary use of tools from the acquisition of knowledge.

Mr. Everett said, "I will thank any person to show why it is expedient and beneficial in the community to make public provision for teaching the elements of learning, and not expedient or beneficial to make similar provision to aid the learner's progress toward the mastery of the most difficult branches of science and the choicest refinements of literature." Under the influence of such considerations the rudimentary studies rapidly developed into courses of study embracing a variety of subjects. This led to the systematizing of instruction and the grading of schools, so that in nearly all the towns of the United States the public schools have been divided into primaries for the younger pupils and grammar-schools for older pupils; while within twenty-five years a third grade has arisen known as the high-schools for the most advanced students. In each division there are sub-grades, and, wherever improvements in public-school education are attempted, the principle of gradation is fundamental. So essential is it considered, that no aid is granted from the Peabody fund except to graded schools. As regards the plan of studies adopted, there was no guiding principle. All sorts of subjects, and these for all sorts of reasons, were taken up, and among them the sciences which are now regular parts of public-school study. Classes are formed in physics, chemistry, mineralogy, geology, physiology, botany, and zoölogy. There are text-books upon all these branches, graded to the varying capacities of learners. Teachers prepare in them, and in many cases apparatus is provided, and there are lectures with experiments, specimens, maps, and charts for illustrations.

The old ideal of a school is a place where knowledge is got from books by the help of teachers, and our public-school system grew up in conformity with this ideal. The early effect of grading was to fix and consolidate imperfect methods. The sciences were assimilated to the old practice, and the science-teaching falls short at just the points where it was inevitable that it should fall short. The methods of school-teaching, and the habits of the teachers, had grown rigid under the *régime* of book-studies. As a consequence the science-teaching in the public schools is generally carried on by *instruction*. Through books and teachers the pupil is filled up with information in regard to science. Its facts and principles are explained as far as possible, and then left in the memory with his other school acquisitions. He learns the sciences much as he learns geography and history. Only in a few exceptional schools is he put to any direct mental work upon the subject-matter of science, or taught to think for himself.

As thus treated the sciences have but little value in education. They fall below other studies as means of mental cultivation. Arithmetic rouses mental reaction. The rational study of language, by analytical and constructive tasks and the mastery of principles, strengthens the mental processes; but the sciences are not employed to train the faculties in the various ways to which they are severally

adapted. They are not made the means of cultivating the observing powers, stimulating inquiry, exercising the judgment in weighing evidence, nor of forming original and independent habits of thought. The pupil does not know the subjects he professes to study by actual acquaintance with the facts, and he therefore becomes a mere passive accumulator of second-hand statements. But it is the first requirement of the scientific method, alike in education and in research, that the mind shall exercise its activity directly upon the subject-matter of study. Otherwise scientific knowledge is an illusion and a cheat. As science is commonly pursued in book descriptions, the learners can not even identify the things they read about. As remarked by Agassiz, "The pupil studies Nature in the school-room, and when he goes out-of-doors he can not find her." This mode of teaching science, which is by no means confined to the public schools, has been condemned in the most unsparing manner by all eminent scientific men as a "deception," a "fraud," an "outrage upon the minds of the young," and "an imposture in education."

Nor has this criticism of bad practices been without its effect. We are met by the statement that much has been done in the public schools to escape the evils of mere book-science. The method of object-lessons has been extensively introduced into primary schools with the professed purpose of cultivating the powers of observation in childhood. It is claimed that this is a beginning in science; and, as it brings the mind into action upon things, is a corrective of the inordinate study of words. But object-teaching has not yielded what was expected of it, and is in no true sense a first step in science. Nothing is gained educationally by barely having an object in hand when it is talked about. Myriads of objects are present to the senses of people, but no insight follows. The observing faculties must be tasked if they are to be trained. The pupil is not to have the properties of objects pointed out, but he is to find them out. Science will do its work of educating the observing faculties only as they are quickened and sharpened by exercise in discrimination. The scientific aim is to replace vague confused impressions by clear and accurate ideas. Skill in the detection of nice distinctions is only gained by prolonged and careful practice. Object-lessons afford no such cultivation. We do not say that they are useless, but they are not the A B C of science, and do not as a matter of fact open the way to the proper study of the special sciences. This is their test and their condemnation. When the primary pupils have gone over their prescribed course of object-lessons and are passed on to a higher grade, strange to say the "objects" are suddenly dropped as if the objective method had been exhausted. In the technical phrase *perceptive* education is to be replaced by *conceptive* education. Instruction in elementary science is now to be carried on by what is known as oral-teaching. This method, as extensively practiced in the grammar grades of the public schools, is everywhere grow-

ing in favor, and we are once more told that it is a successful revolt against book-studies. It is chiefly applicable to the sciences, and its cardinal idea is instruction without a text-book. This looks fair, but it is delusive. The method does not remove the book that the pupil may come at the phenomena, but it removes the book that the teacher may take its place. Oral-teaching is class-instruction, in which information is imparted in a familiar manner with the view of awakening the interest of the class. But, so far as real science is concerned, it is doubtful if this method is not worse than the one it replaces. Following the maxim of certain German educators, that "the teacher is the school," it was assumed that when apathy prevails in the school-room it is solely the teachers' fault. Oral exercises enable them to escape this reproach by giving animation to school-work. It is said that this is a "live system" in contrast to the old humdrum routine of lessons and recitations. But science gets no real help. There is only the substitution of a superficial class-activity for the more deliberate work of the individual pupil. More mental effort is required on his part to get a lesson from a book than to listen to a lesson given by the teacher. The teacher is to do everything, and stands in the place not only of the book but of the pupil also. Is this not a step backward in education? The teacher is magnified at the expense of close study, and science is cheapened by the method. Oral-teaching implies a fertility, a versatility, and a proficiency in scientific knowledge on the part of teachers which that class of persons does not possess. It is a premium on tutorial smattering and cramming by which the voluble teacher with superficial acquisitions and a ready memory becomes the model teacher. There may be benefits in this method, but science does not gain them. Judicious oral assistance, as in the physical, chemical, or natural history laboratory, given by a competent master to a pupil at work, is invaluable for stimulus and guidance; but the aid must be discreet, and the skillful teacher will not talk too much. But where it is all talk and no work, and text-books are filtered through the very imperfect medium of the ordinary teacher's mind, and the pupil has nothing to do but to be instructed, every sound principle of education is outraged, and science is only made ridiculous.

This failure to gain the benefits of real scientific study has its source deep in the constitution of the public schools. In dealing with masses of children, classification became necessary, which gave rise, as we have seen, to grading and an elaborate mechanical system. The working of children in lots seems to be a necessity of the public schools, but it strengthens the practice of verbal instruction, recitations, and lesson-giving. It is well fitted to impress the public with the idea that there is much done in the schools. There are a prescribed routine of operations and a display of order that are admired. But teacher and learner are subordinated to the system. It is machine-work, and machines make no allowances. Gradation assumes and enforces a uni-

formity among pupils which is not according to the facts. Wide personal differences of capacity, aptitude, attainment, and opportunity, not only exist among children, but they are the prime data of all efficient mental cultivation. In the graded schools, just in proportion to the perfection of the mechanical arrangements, individuality disappears. Special original capacity, the main thing, counts for nothing. The mind can not be trained in such circumstances to originate its own judgments. The exercise of original mental power, or independent inquiry, is the very essence of the scientific method, and with this the practice of the public schools is at war. Moreover, a system which deals with the average mind, and does not get at the individual mind, breaks down at the point where all true education really begins, that is, in promoting self-culture. The value of educational systems consists simply in what they do to incite the pupil to help himself. Mechanical school-work can give instruction, but it can not develop faculty, because this depends upon self-exertion. Science, if rightly pursued, is the most valuable school of self-instruction. From the beginning men of science have been self-dependent and self-reliant because self-taught; and it is a question whether they have been most hindered or helped by the schools. De Candolle, in his valuable book on the conditions which favor the production of scientific men, says that the discoverers, the masters of scientific method, have chiefly appeared in small towns where educational resources have been scanty; and that they have often been most helped by the very poorness of their teaching, which threw them back upon themselves. It was to their advantage that the schools were not so perfect as to extinguish individuality and thus destroy originality.

Our strictures are here upon the general working of the public-school system; but we recognize that there are many exceptional teachers who do what they can to deal with science in the true spirit, while multitudes of instructors are chafing under present restrictions and groping after something better. The bad system is, moreover, continued chiefly from the lack of knowledge as to the possibilities of a better. But the better method of teaching science has been proved entirely practicable. The institution where we meet and many other science schools have shown it. A large number of teachers have demonstrated that various branches of science can be taught to the young by the true as well as by the false method. What is now most urgently needed is to gather from these experiences practical plans of improvement in science-teaching for the benefit of those who desire better guidance than they now have.

In his address as Rector of the University of Aberdeen, Professor Huxley said, "I would not raise a finger to introduce more book-work into every art curriculum in the country." We concur in this view, as applied to the present science-teaching in our public schools. We would not raise a finger to extend it.

President Barnard, of Columbia College, in a public address reprobating in severe terms the common method of teaching science as being an inversion of the true order of cultivating the mental faculties, referred to the great benefits which must arise "when our systems of education shall have been remodeled from top to bottom." That result may come about in the fullness of time, but it is wise to expect only a slow and gradual improvement. Vice-President Grote, in his St. Louis address, pointed out the guiding principle in this case as a substitution of real knowledge for second-hand information by a necessary law of mental advancement. In obedience to this principle, the cultivators of original science should do what they may to raise the standard of our prevalent science-teaching; and we respectfully ask that the Association will assign to a committee the duty of reporting at our next meeting on the best modes of improving the teaching of science in our public schools.

E. L. Youmans,
A. R. Grote,
J. W. Powell,
N. S. Shaler,
J. S. Newberry,
} *Committee.*

THE CHEMISTRY OF COOKERY.

By W. MATTIEU WILLIAMS.

I.—INTRODUCTORY SUGGESTIONS.

THE philosopher who first perceived and announced the fact that all the physical doings of man consist simply in changing the places of things made a very profound generalization, and one that is worthy of more serious consideration than it has received.

All our handicraft, however great may be the skill employed, amounts to no more than this. The miner moves the ore and the fuel from their subterranean resting-places, then they are moved into the furnace, and by another moving of combustibles the working of the furnace is started; then the metals are moved to the foundries and forges, then under hammers, or squeezers, or into melting-pots, and thence to molds. The workman shapes the bars, or plates, or castings, by removing a part of their substance, and by more and more movings of material produces the engine, which does its work when fuel and water are moved into its fireplace and boiler.

The statue is within the rough block of marble; the sculptor merely removes the outer portions, and thereby renders his artistic conception visible to his fellow-men.

The agriculturist merely moves the soil in order that it may receive

the seed, which he then moves into it, and, when the growth is completed, he moves the result, and thereby makes his harvest.

The same may be said of every other operation. Man alters the position of physical things in such wise that the forces of Nature shall operate upon them and produce the changes or other results that he requires.

My reasons for this introductory digression will be easily understood, as this view of the doings of man and the doings of Nature displays fundamentally the business of human education, so far as the physical proceedings and physical welfare of mankind are concerned.

It clearly points out two well-marked natural divisions of such education: education or training in the movements to be made, and education in a knowledge of the consequences of such movements—i. e., in a knowledge of the forces of Nature which actually do the work when man has suitably arranged the materials.

The education ordinarily given to apprentices in the workshop, or the field, or the studio—or, as relating to my present subject, the kitchen—is the first of these; the second, and equally necessary, being simply and purely the teaching of physical science as applied to the arts.

I can not proceed any further without a protest against a very general (so far as this country is concerned) misuse of a now very popular term—a misuse that is rather surprising, seeing that it is accepted by scholars who have devoted the best of their intellectual efforts to the study of words. I refer to the word *technical* as applied in the designation "technical education."

So long as our workshops are separated from our science-schools and colleges, it is most desirable, in order to avoid continual circumlocution, to have terms that shall properly distinguish between the work of the two, and admit of definite and consistent use. The two words are ready at hand, and, although of Greek origin, have become by analogous usage plain, simple English. I mean the words *technical* and *technological*.

The Greek noun *techne* signifies an art, trade, or profession, and our established usage of this root is in accordance with this signification. Therefore "technical education" is a suitable and proper designation of the training which is given to apprentices, etc., in the strictly technical details of their trades, arts, or professions. When we require a name for the science or the philosophy of anything, we obtain it by using the Greek root *logos*, and appending it in English form to the Greek name of the general subject, as geology, the science of the earth; anthropology, the science of man; biology, the science of life, etc.

Why not, then, follow this general usage, and adopt "technology" as the science of trades, arts, or professions, and thereby obtain consistent and convenient terms to designate the two divisions of educa-

tion—technical education, that given in the workshop, etc.; and technological education, that which should be given as supplementary to all such technical education?

In accordance with this, the papers I am here commencing will be a contribution to the technology of cookery, or to the technological education of cooks, whose technical education is quite beyond my reach.

The kitchen is a chemical laboratory, in which are conducted a number of chemical processes, by which our food is converted from its crude state to a condition more suitable for digestion and nutrition, and made more agreeable to the palate.

It is the *rationale* or *ology* of these processes that I shall endeavor to explain; but at the outset it is only fair to say that in many instances I shall not succeed in doing this satisfactorily, as there still remain some kitchen mysteries that have not yet come within the firm grasp of science. The *whole* story of the chemical differences between a roast, a boiled, and a raw leg of mutton, has not yet been told. You and I, gentle reader, aided by no other apparatus than a knife and fork, can easily detect the difference between a cut out of the saddle of a three-year-old Southdown and one from a ten-months-old meadow-fed Leicester; but the chemist in his laboratory, with all his re-agents, test-tubes, beakers, combustion-tubes, potash-bulbs, etc., etc., and his balance turning to one-thousandth of a grain, could not physically demonstrate the sources of these differences of flavor.

Still, I hope to show that modern chemistry can throw into the kitchen a great deal of light that shall not merely help the cook in doing his or her work more efficiently, but shall elevate both the work and the worker, and render the kitchen far more interesting to all intelligent people who have an appetite for knowledge, as well as for food, than it can be while the cook is groping in rule-of-thumb darkness—is merely a technical operator unenlightened by technological intelligence.

In the course of these papers I shall draw largely on the practical and philosophical work of that remarkable man, Benjamin Thompson, the Massachusetts prentice-boy and schoolmaster; afterward the British soldier and diplomatist, Colonel Sir Benjamin Thompson; then colonel of horse and general aide-de-camp of the Elector Charles Theodore, of Bavaria; then major-general of cavalry, Privy Councilor of State, and head of War Department of Bavaria; then Count Rumford of the Holy Roman Empire, and order of the White Eagle; then Military Dictator of Bavaria, with full governing powers during the absence of the Elector; then a private resident in Brompton Road, and founder of the Royal Institution in Albemarle Street; then a Parisian *citoyen*, the husband of the "Goddess of Reason," the widow of Lavoisier; but above all a practical and scientific cook, whose exploits in economic cookery are still but very imperfectly appreciated, though

he himself evidently regarded them as the most important of all his varied achievements.

His faith in cookery is well expressed in the following, where he is speaking of his experiments in feeding the Bavarian army and the poor of Munich. He says: "I constantly found that the richness or quality of a soup depended more upon the proper choice of the ingredients, and a proper management of the fire in the combination of these ingredients, than upon the quantity of solid nutritious matter employed; much more upon the art and skill of the cook than upon the sums laid out in the market."

A great many fallacies are continually perpetrated, not only by ignorant people, but even by eminent chemists and physiologists, by inattention to what is indicated in this passage. In many chemical and physiological works may be found elaborately minute tables of the chemical composition of certain articles of food, and with these the assumption (either directly stated, or implied, as a matter of course) that such tables represent the practical nutritive value of the food. The illusory character of such assumption is easily understood. In the first place, the analysis is usually that of the article of food in its raw state, and thus all the chemical changes involved in the process of cookery are ignored.

Secondly, the difficulty or facility of assimilation is too often unheeded. This depends both upon the original condition of the food and the changes which the cookery has produced—changes which may double its nutritive value without effecting more than a small percentage of alteration in its chemical composition, as revealed by laboratory analysis.

In the recent discussion on whole-meal bread, for example, chemical analyses of the bran, etc., are quoted, and it is commonly assumed that, if these can be shown to contain more of the theoretical bone-making or brain-making elements, they are, therefore, in reference to these requirements, more nutritious than the fine flour. But, before we are justified in asserting this, it must be made clear that these ordinarily rejected portions of the grain are as easily digested and assimilated as the finer inner flour.

I think I shall be able to show that the practical failure of this whole-meal bread movement (which is not a novelty, but only a revival) is mainly due to the disregard of the cookery question; that whole-meal prepared as bread by simple baking is less nutritious than fine flour similarly prepared; but that whole-meal otherwise prepared may be, and has been, made more nutritious than fine white bread.

Count Rumford supplies us with important data toward the solution of this difficulty.

Another preliminary example. A pound of bread or biscuit contains more solid nutritive matter than a pound of beefsteak, but does

not, when eaten by ordinary mortals, do so much nutritive work. Why is this?

It is a matter of preparation—not exactly what is called cooking, but equivalent to what cooking should be. It is the preparation which has converted the grass-food of the ox into another kind of food which we can assimilate very easily.

The fact that we use the digestive and nutrient apparatus of sheep, oxen, etc., for the preparation of our food is merely a transitory barbarism, to be ultimately superseded when my present subject is sufficiently understood and applied to enable us to prepare the constituents of the vegetable kingdom in such a manner that they shall be as easily assimilated as the prepared grass which we call beef and mutton, and which we now use only on account of our ignorance of "The Chemistry of Cooking."

II.—THE BOILING OF WATER.

As this is one of the most rudimentary of the operations of cookery, and the most frequently performed, it naturally takes a first place in treating the subject.

Water is boiled in the kitchen for two distinct purposes: 1. For the cooking of itself; 2. For the cooking of other things. A dissertation on the difference between raw water and cooked water may appear pedantic, but, as I shall presently show, it is considerable, very practical, and important.

The best way to study any physical subject is to examine it experimentally, but this is not always possible with every-day means. In this case, however, there is no difficulty.

Take a thin* glass vessel, such as a flask, or, better, one of the "beakers," or thin, tumbler-shaped vessels, so largely used in chemical laboratories; partially fill it with ordinary household water, and then place it over the flame of a spirit-lamp, or Bunsen's, or other smokeless gas-burner. Carefully watch the result, and the following will be observed: First of all little bubbles will be formed, adhering to the sides of the glass, but ultimately rising to the surface, and there becoming dissipated by diffusion in the air.

This is not boiling, as may be proved by trying the temperature with the finger. What, then, is it?

It is the yielding back of the atmospheric gases which the water has dissolved or condensed within itself. These bubbles have been collected and by analysis proved to consist of oxygen, nitrogen, and carbonic acid, obtained from the air; but in the water they exist by no means in the same proportions as originally in the air, nor in con-

* In applying heat to glass vessels, thickness is a source of weakness or liability to fracture, on account of the unequal expansion of the two sides, due to inequality of temperature, which, of course, increases with the thickness of the glass. Besides this, the thickness increases the leverage of the breaking strain.

stant proportions in different samples of water. I need not here go into the quantitative details of these proportions, nor the reasons of their variation, though they are very interesting subjects.

Proceeding with our investigation, we shall find that the bubbles continue to form and rise until the water becomes too hot for the finger to bear immersion. At about this stage something else begins to occur. Much larger bubbles, or rather blisters, are now formed on the bottom of the vessel, immediately over the flame, and they continually collapse into apparent nothingness. Even at this stage a thermometer immersed in the water will show that the boiling-point is not reached. As the temperature rises, these blisters rise higher and higher, become more and more nearly spherical, finally quite so, then detach themselves and rise toward the surface; but the first that make this venture perish in the attempt—they gradually collapse as they rise, and vanish before reaching the surface. The thermometer now shows that the boiling-point is nearly reached, but not quite. Presently the bubbles rise completely to the surface and break there. Now the water is boiling, and the thermometer stands at 212° Fahr. or 100° Cent.

With the aid of suitable apparatus it can be shown that the atmospheric gases above named continue to be given off along with the steam for a considerable time after the boiling has commenced; the complete removal of their last traces being a very difficult, if not an impossible, physical problem.

After a moderate period of boiling, however, we may practically regard the water as free from these gases. In this condition I venture to call it cooked water. Our experiment so far indicates one of the differences between cooked and raw water. The cooked water has been deprived of the atmospheric gases that the raw water contained. By cooling some of the cooked water and tasting it the difference of flavor is very perceptible; by no means improved, though it is quite possible to acquire a preference for this flat, tasteless liquid.

If a fish be placed in such cooked water it swims for a while with its mouth at the surface of the water, for just there is a film that is reacquiring its charge of oxygen, etc., by absorbing it from the air; but this film is so thin and so poorly charged, that after a short struggle the fish dies for lack of oxygen in its blood, drowned as truly and completely as a living, breathing animal when immersed in any kind of water.

Spring and river water that have passed through or over considerable distances in calcareous districts suffer another change in boiling. The origin and nature of this change may be shown by another experiment as follows: Buy a pennyworth of lime-water from a druggist, and procure a small glass tube of about quill-size, or the stem of a fresh tobacco-pipe may be used. Half fill a small wine-glass with the lime-water, and blow through it by means of the tube of the to-

bacco-pipe. Presently it will become turbid. Continue the blowing, and the turbidity will increase up to a certain degree of milkiness. Go on blowing with "commendable perseverance," and an inversion of effect will follow: the turbidity diminishes, and at last the water becomes clear again.

The chemistry of this is simple enough. From the lungs a mixture of nitrogen, oxygen, and carbonic acid is exhaled. The carbonic acid combines with the soluble lime and forms a carbonate of lime which is insoluble in mere water. But this carbonate of lime is to a certain extent soluble in water saturated with carbonic acid, and such saturation is effected by the continuation of blowing.

Now take some of the lime-water that has been thus treated, place it in a clean glass flask, and boil it. After a short time the flask will be found incrusted with a thin film of something. This is the carbonate of lime, which has been thrown down again by the action of boiling in drawing off its solvent, the carbonic acid. This crust will effervesce if a little acid is added to it.

In this manner our tea-kettles, engine-boilers, etc., become incrusted when fed with calcareous waters, and most waters are calcareous; those supplied to London, which is surrounded by chalk, are largely so. Thus the boiling or cooking of such water effects a removal of its mineral impurities more or less completely. Other waters contain such mineral matter as salts of sodium and potassium. These are not removable by mere boiling.

Usually we have no very strong motive for removing either these or the dissolved carbonate of lime, or the atmospheric gases from water, but there is another class of impurities of serious importance. These are the organic matters dissolved in all water that has run over land covered with vegetable growth, or, more especially, which has received contributions from sewers or any other form of house-drainage. Such water supplies nutriment to those microscopic abominations, the *mirococci*, *bacilli*, *bacteria*, etc., which are now shown to be connected with blood-poisoning—possibly do the whole of the poisoning business. These little pests are harmless, and probably nutritious, when cooked, but in their raw and wriggling state are horribly prolific in the blood of people who are in certain states of what is called "receptivity." They (the bacteria, etc.) appear to be poisoned or somehow killed off by the digestive secretions of the blood of some people, and nourished luxuriantly in the blood of others. As nobody can be quite sure to which class he belongs, or may presently belong, or whether the water supplied to his household is free from blood-poisoning organisms, cooked water is a safer beverage than raw water.

The requirement for this simple operation of cooking increases with the density of our population, which on reaching a certain degree renders the pollution of all water obtained from the ordinary sources almost inevitable.

Reflecting on this subject, I have been struck with a curious fact that has hitherto escaped notice, viz., that, in the country which over all others combines a very large population with a very small allowance of cleanliness, the ordinary drink of the people is boiled water flavored by an infusion of leaves. These people, the Chinese, seem, in fact, to have been the inventors of boiled-water beverages. Judging from travelers' accounts of the state of the rivers, rivulets, and general drainage and irrigation arrangements of China, its population could scarcely have reached its present density if Chinamen were drinkers of raw instead of cooked water.

III.—COOKING UNDER WATER.

Next to the boiling of water for its own sake, as treated in my last, comes the boiling of water as a medium for the cooking of other things. Here, at the outset, I have to correct an error of language which, as too often happens, leads by continual suggestion to false ideas. When we speak of "boiled beef," "boiled mutton," "boiled eggs," "boiled potatoes," we talk nonsense; we are not merely using an elliptical expression, as when we say "the kettle boils," which we all understand to mean the contents of the kettle, but we are expounding a false theory of what has happened to the beef, etc.—as false as though we should describe the material of the kettle that has held boiling water as boiled copper or boiled iron. No boiling of the food takes place in any such cases as the above-named—it is merely heated by immersion in boiling water; the changes that actually take place in the food are essentially different from those of ebullition. Even the water contained in the meat is not boiled in ordinary cases, as its boiling-point is higher than that of the surrounding water, owing to the salts it holds in solution.

Thus, as a matter of chemical fact, a "boiled leg of mutton" is one that has been cooked, but not boiled; while a roasted leg of mutton is one that has been partially boiled. Much of the constituent water of flesh is boiled out, fairly driven away as vapor during roasting or baking, and the fat on its surface is also boiled, and, more or less, dissociated into its chemical elements, carbon and water, as shown by the browning, due to the separated carbon.

As I shall presently show, this verbal explanation is no mere verbal quibble, but it involves important practical applications. An enormous waste of precious fuel is perpetrated every day, throughout the whole length and breadth of Britain and other countries where English cookery prevails, on account of the almost universal ignorance of the philosophy of the so-called boiling of food.

When it is once fairly understood that the meat is not to be boiled, but is merely to be warmed by immersion in water raised to a maximum temperature of 212°, and when it is further understood that water can not (under ordinary atmospheric pressure) be raised to a higher

temperature than 212° by any amount of violent boiling, the popular distinction between "simmering" and boiling, which is so obstinately maintained as a kitchen superstition, is demolished.

The experiment described in my last showed that immediately the bubbles of steam reach the surface of the water and break there—that is, when simmering commences—the thermometer reaches the boiling-point, and that however violently the boiling may afterward occur, the thermometer rises no higher. Therefore, as a medium for heating the substance to be cooked, simmering water is just as effective as "walloping" water. There are exceptional operations of cookery, to be described hereafter, wherein useful mechanical work is done by violent boiling; but in all ordinary cookery, simmering is just as effective. The heat that is applied to do more than the smallest degree of simmering is simply wasted in converting water into useless steam. The amount of such waste may be easily estimated. To raise a given quantity of water from the freezing to the boiling point demands an amount of heat represented by 180° in Fahrenheit's thermometer, or 100° Centigrade. To convert this into steam, 990° Fahr. or 500° Cent. is necessary—just five and a half times as much.

On a properly-constructed hot-plate or sand-bath, a dozen saucepans may be kept at the true cooking temperature, with an expenditure of fuel commonly employed in England to "boil" one saucepan. In the great majority of so-called boiling operations, even simmering is unnecessary. Not only is a "boiled leg of mutton" not itself boiled, but even the water in which it is cooked should not be kept boiling, as we shall presently see.

In order to illustrate some of the changes which take place in the cooking of animal food, I will first take the simple case of cooking an egg by means of hot water. These changes are in this case easily visible and very simple, although the egg itself contains all the materials of a complete animal. Bones, muscles, viscera, brain, nerves, and feathers of the chicken—all are produced within the shell, nothing being added, and little or nothing taken away.

When we open a raw egg, we find, enveloped in a stoutish membrane, a quantity of glairy, slimy, viscous, colorless fluid, which, as everybody now knows, is called *albumen*, a Latin translation of its common name, "*the white*." Within the white of the egg is the yolk, largely composed of that same albumen, but with other constituents added—notably a peculiar oil. At present I will only consider the changes which cookery effects on the main constituent of the egg, merely adding that this same albumen is one of the most important, if not the one most important, material of animal food, and is represented by a corresponding nutritious constituent in vegetables.

We all know that when an egg has been immersed during a few minutes in boiling water, the colorless, slimy liquid is converted into the white solid to which it owes its name. This coagulation of albu-

men is one of the most decided and best understood changes effected by cookery, and therefore demands especial study.

Place some fresh, raw white of egg in a test-tube, or other suitable glass vessel, and in the midst of it immerse the bulb of a thermometer. (Cylindrical thermometers, with the degrees marked on the glass stem, are made for such laboratory purposes.) Place the tube containing the albumen in a vessel of water, and gradually heat this. When the albumen attains a temperature of about 134° Fahr., white fibers will begin to appear within it; these will increase until about 160° is attained, when the whole mass will become white and nearly opaque. It is now coagulated, and may be called solid. Now examine some of the result, and you will find that the albumen thus only just coagulated is a tender, delicate, jelly-like substance, having every appearance to sight, touch, and taste of being easily digestible. This is the case.

Having settled these points, proceed with the experiment by heating the remainder of the albumen (or a new sample) up to 212°, and keeping it for a while at this temperature. It will dry, shrink, and become horny. If the heat is carried a little further, it becomes converted into a substance which is so hard and tough that a valuable cement is obtained by simply smearing the edges of the article to be cemented with white of egg, and then heating it to a little above 212°.*

This simple experiment teaches a great deal of what is but little known concerning the philosophy of cookery. It shows in the first place that, so far as the coagulation of the albumen is concerned, the cooking temperature is not 212°, or that of boiling water, but 160°, i. e., 52° below it. Everybody knows the difference between a tender, juicy steak, rounded or plumped-out in the middle, and a tough, leathery abomination, that has been so cooked as to shrivel and curl up. The contraction, drying up, and hornifying of the albumen in the test-tube represent the albumen of the latter, while the tender, delicate, trembling, semi-solid, that was coagulated at 160°, represents the albumen in the first.

But this is a digression, or rather anticipation, seeing that the grilling of a beefsteak is a problem of profound complexity that we can not solve until we have mastered the rudiments. We have not yet determined how to practically apply the laws of albumen coagulation as discovered by our test-tube experiment to the cooking of a breakfast-egg.—*Knowledge.*

* "Egg-cement," made by thickening white of egg with finely-powdered quicklime, has long been used for mending alabaster, marble, etc. For joining fragments of fossils and mineralogical specimens, it will be found very useful. White of egg alone may be used, if carefully heated afterward.

OUR MARRIAGE AND DIVORCE LAWS.

By GORDON A. STEWART.

THE worst of our social evils, personal wrongs, and political sins arise from the ununiform operation of our marriage and divorce laws. The loose manner in which a contract of marriage may be entered into and the reckless facility with which a marriage contract may be dissolved are a disgrace to our high civilization and professed Christianity. However learned commentators and jurists may differ as to the correct definition of marriage, it is not only a partially executed agreement to marry, but is a contract continuous in its obligations governing the status of the parties, until it is dissolved by the death of one of the parties, or by one of them obtaining a divorce for some wrongful or invalidating act committed by the other.

In nearly all of the States marriage is recognized as a civil contract only, and has no ecclesiastical obligation so far as society and the State are concerned. The contracting parties are subjects of the law. The person performing the ceremony by which the contract is publicly acknowledged by the parties, whether he be magistrate, parson, or layman, becomes a civil officer by authority of the law for that occasion. Generally, however, the marriage contract is solemnized by a clergyman, agreeably to the rules and regulations of the religious denomination to which he belongs, and for which one or the other of the parties has a religious attachment or preference; or, because a religious solemnization in church gives a better opportunity to gratify the desire for social rivalry and display. But perhaps most persons, especially when young and looking forward to a long future of connubial happiness, consider the act of marriage more as a religious rite than a civil contract, and hence the forms and ceremonies of the Church accord more agreeably with the sentiment of love and affection than the business-like and informal words of the magistrate, who, in response to their acknowledgment of intention to marry, simply pronounces them man and wife. This sentiment, no doubt, is largely the result of a lingering belief in marriage as a divine institution and a sacrament of the Church, as taught when the ecclesiastical court had exclusive jurisdiction of marriage and divorce. It is perhaps not until later, not until they have become dissatisfied with the conditions of the solemn obligation they had agreed to faithfully perform through life, that they discover it is simply a civil contract that binds them, and from which the law has generously provided unlimited means of escape.

Lawful marriage is the basis of the family relation, and the family relation is the fundamental principle of association upon which the superstructure of society and the State is built. And yet there is no

contract of the value of twenty dollars, subject to the verdict of a jury or the decision of a court, that is so easily avoided and so shamefully dissolved as the contract of marriage. The facts show that the law and the courts enforce the obligations of a delinquent debtor with more severity than the obligations of this contract upon which the happiness of the family, the morality of society, and the perpetuity of the State depend. The marriage contract is of a higher inspiration, and has a broader obligation, than a mere contract for the payment of money, or for the transfer of property, or for co-operation in business. It is one in which society is more deeply interested, one by which society is more seriously affected; and society has the right to demand that the mutual obligations shall be faithfully kept and lawfully enforced.

This lack of uniformity in the laws, both in their formulation and execution, is the result of the diversity of sources from which they emanate. Each State is its own authority, and determines for itself the conditions upon which the marriage relation of its people may be entered into or dissolved; and, perhaps, the social and moral sentiment of the people of a State can not be more equitably determined than by observing the character and use of its laws governing marriage and divorce; forthe various degrees of restriction and laxity in marriage and divorce have marked the progress and decline of all peoples and nations ever since the days when Adam and Eve went out of paradise and Moses wrote the law on Mount Sinai. Several States still retain upon their statute-books the common-law prohibition of marriage between persons related by consanguinity, or affinity, nearer than the third degree; while other States have progressed to that degree of liberality on the road to individual freedom and universal happiness which permits a person to marry, if not his grandmother, at least the daughter of his wife by a former husband. So we find that while two persons within certain degrees of relationship may lawfully marry in one State, they are prohibited from marrying by the laws of another State; and that while a marriage between certain persons is voidable only in one State, it is absolutely void under a similar law in another State.

It would be interesting to review at length the marriage and divorce laws of the several States, and note their want of uniform operation; but, for the purposes of this article, which must be brief, I shall confine myself to a comparative notice of the laws of two or three States only. In Ohio, "male persons of the age of eighteen years, and female persons of the age of sixteen years, not nearer kin than second-cousins, and not having a husband or wife living, may be joined in marriage," provided that if the male person is under the age of twenty-one, and the female person is under the age of eighteen, they shall first obtain the consent of their parents, respectively. The marriage may be solemnized by an ordained minister of any religious congregation who has first obtained a license authorizing him to solemnize marriages; or

by a justice of the peace in his county; or by the several religious societies agreeably to the rules and regulations of their respective churches. If the parties are married by the rules of any church, notice of the marriage must first be published in the presence of the congregation on two separate days of worship, the first notice to be at least ten days previous to such marriage, and in the county in which the female resides. And, in order that record evidence of a marriage may always exist, a license to marry must first be obtained from the probate court before the marriage can be legally solemnized; and a certificate of such marriage, signed by the minister or justice of the peace solemnizing the same, must be filed by the person so officiating with the court where the license issued. This certificate must be filed with the court within three months from date of marriage, under a penalty of fifty dollars fine for neglect to do so, and the court must make a record of the certificate of marriage under a like penalty. These last provisions do not apply to parties who are married by the rules of any church.

In New York, marriage, so far as its validity in law is concerned, is expressly declared to be a civil contract, to which the consent of the parties, who must be capable in law of contracting, is essential. Marriage between parents and children, and grandparents and grandchildren, of every degree, and between brothers and sisters of the half or whole blood, are declared to be incestuous and absolutely void. So a second or other subsequent marriage contracted by any person during the lifetime of any former husband or wife of such person, is absolutely void, unless the marriage of such former husband or wife shall have been annulled for some cause other than the adultery of such person, or unless such former husband or wife shall have been finally sentenced to imprisonment for life. But for causes existing at the time of marriage, where either of the parties is incapable of contracting for want of age or understanding, or from physical causes, or where consent has been obtained through force or fraud, the marriage is void only from the time its nullity shall be declared by a court of competent authority. So, if any person, whose husband or wife shall have absented himself or herself for the space of five consecutive years without being known to such person to be living during that time, shall marry during the lifetime of such absent husband or wife, the marriage shall be void only from the time its nullity is pronounced by a court of competent authority. The law authorizing a legal separation, or a limited divorce, in New York, has been repealed, and the only causes arising after marriage for which a legal marriage can be annulled are adultery and imprisonment for life; and a pardon to the person sentenced to imprisonment for life will not restore to him or her the rights of a previous marriage. In a case of divorce for adultery the complainant may marry again during the life of the defendant; but no defendant convicted of adultery can marry again until the death of the complain-

ant, unless the court in which the judgment of divorce was rendered shall modify such judgment on satisfactory proof that the complainant has remarried, that five years have elapsed since the divorce was granted, and that the conduct of the defendant since the dissolution of the marriage has been uniformly good.

No formality is necessary for the solemnization of marriages in New York. But, for the purpose of being registered and authenticated, the statute provides that marriages may be solemnized by ministers of the gospel and priests; and when solemnized by them the ceremony must be according to the forms and customs of the church or society to which they belong. Marriages may also be solemnized by mayors, recorders, and aldermen of cities, judges of the county court, justices of the peace, and by justices and judges of courts of record. When solemnized by a magistrate, no particular form is required, except that the parties shall declare in the presence of the magistrate and attending witnesses that they take each other for husband and wife. It is the duty of the officiating minister or magistrate to enter the names, ages, and residences of the parties, and the witnesses to the marriage, in a book to be kept for that purpose, and he shall upon application furnish to the parties a certificate of such marriage. This certificate, if presented to the clerk of the city or town where the marriage was solemnized, or where either of the parties resides, shall be filed by such clerk and entered in a book. The entry, or a certified copy thereof, or the marriage certificate, shall be received as evidence of such marriage. The provisions of the law regulating the solemnization of marriages, however, do not apply to the people called Quakers, nor to Jews, who are married according to the regulations of their respective churches.

In Connecticut the statute declares that no man shall marry his mother, grandmother, daughter, granddaughter, sister, aunt, niece, step-mother or step-daughter; that no woman shall marry her father, grandfather, son, grandson, brother, uncle, nephew, step-father, or step-son; and that, if any man or woman shall marry within the degrees aforesaid, such marriage shall be void. It provides further that no persons shall be married until one of them shall inform the register of the town, or the town-clerk, in which the marriage is to be celebrated, of the name, age, color, occupation, birthplace, residence, and condition—whether single, widowed, or divorced—of each. Such register, or town-clerk, shall thereupon issue his certificate that the parties therein named have complied with the law, which certificate shall be a license for any person authorized to solemnize marriages to give in marriage, in said town only, the parties therein named; but no such certificate shall be issued if either of the parties is a minor, under the control of a parent or a guardian, until such parent or guardian shall give to the register, or town-clerk, his written consent; and any register, or town-clerk, who shall knowingly issue such certificate without

such consent, shall forfeit to the State one hundred dollars; and any person who shall join any persons in marriage without having received such certificate shall forfeit a like sum of one hundred dollars. Every person who shall join any persons in marriage shall certify upon the license certificate the fact, time, and place of such marriage, and return it to the register of the town where it was issued, before or during the first week of the month next succeeding such marriage, and upon failure thereof shall forfeit ten dollars. The certificate shall be *prima facie* evidence of such marriage. All judges, justices of the peace, and ordained or licensed clergymen while in the ministry, may join persons in marriage, and all marriages attempted to be celebrated by any other person shall be void; but all marriages which shall be solemnized according to the forms and usages of any religious denomination in the State shall be valid.

While the laws of these three States differ—and, perhaps, no two States in the Union agree as to who are competent to contract marriage—the provisions of the statutes of each regulating its solemnization would seem to be sufficient to protect society against hasty and indiscriminate alliances, to guard either party against fraud, and to furnish record evidence in any case where proof of marriage might be required. And yet, upon the provisions of the statutes defining *who* may solemnize marriages, the greatest confusion prevails throughout the Union between the courts and the law. In Connecticut, we have seen that "all marriages attempted to be celebrated by any other person" (than those named) "shall be void." In Ohio and New York, and in many other States, where no words of nullity are expressed in the statutes, such marriages are held valid.

But in Massachusetts, and in several other States, it has been held, where no words of nullity are expressed, that such marriages are not valid. And yet, it is generally accepted as the law, on principle, notwithstanding the marriage is celebrated without license, and the ceremony performed by an unauthorized person, that if the parties simply by mutual consent agree to marry, and live together as man and wife, such consent and cohabitation are valid and binding between the parties, and the issue thereof are entitled to all the rights of legitimate children. To reverse this common-law doctrine by general statutory provisions might work hardship in some individual cases; but its existence works more harm to society and bastardizes more children than would the enactment of stringent marriage laws, for parties would then be more careful and not enter into such relation without proof of marriage. Marriage is not a contract to be entered into in haste and repented of at leisure. It is of more importance to the parties, and far more to society, than the acquirement of a good title to a piece of real estate. Yet no one would think it a hardship to comply with the law for the proper execution and registration of a deed of conveyance, and no court would hold, as a general rule, that a valid title passed,

although the statute governing the transfer had not been complied with.

In these three States, and in most of the States, the laws regulating the solemnization of marriages except from their general provisions certain religious denominations. This exception was an early spasm of religious toleration, entirely out of date in this tolerant age. Marriage being a civil contract between two persons, its conditions should be performed by them, of whatever religious faith they may be, the same as they would have to perform the conditions of any other civil contract or legal obligation. The exception is anti-constitutional, in establishing a religious distinction even as against the Catholic Church, which still holds marriage as a divine institution, and its celebration a sacrament of the Church. No such exception is made in the execution of any other legal contract or in favor of other religious sects, and no hardship or violation of conscience or religious belief could follow the abolition of this incongruity. As members of society and citizens of the State, all persons should conform to the same civil law, leaving the individual parties free to supplement the civil ceremony with a religious one, according to the rules of the religious society to which they belong.

There is a peculiarity in the marriage contract, that does not enter into any other contract in the ordinary commercial transactions of life. While others may be, it must be between one man and one woman only. The contract does not end with the marriage ceremony; its conditions are for life, and continue until dissolved by death or divorce. Once it might have been considered to end with the solemnization, and to take on the form of a status, but that was in those days when on the "nuptial day" all the identity of the woman, her personality, individuality, right of property, and control of offspring, were merged in the man, and he became her lord and master, leaving her without the right of appeal to any civil authority for the redress of any wrong. But the barbarism of those days is fading away, and the light of a new civilization is dawning, though still confused here and there by old forms and prejudices. When woman shall stand before the law equal with man in all her personal, property, and political rights, then indeed will marriage be a contract sanctioned by nature and approved by God. All the instincts of nature favor marriage, all the passions, desires, and affections of the human heart enter into it, and the highest development of the human race depends upon it. Yet, as a part of the contract, the law of divorce enters in; and, while it is over-rigid in some States, in others its laxity almost neutralizes the fundamental idea of the continuance and perpetuity of the marriage obligation.

As a relic of that "peculiar institution," with its concubinal practice between whites and blacks, South Carolina preserves its old laws which allow no cause for divorce. In New York there is one cause

only. In Ohio and other States there are many; but in Connecticut, Indiana, Illinois, North Carolina, and Maine, there is any cause that a discontented and dishonest party may allege, or that a judge in his discretion, influenced by sympathy or corrupt motives, may approve. In these extremes of the law, we have the tyranny of bigotry and the liberty of license, this opening the gates of temptation to the licentiousness of man, and the other driving in the victims. Surely there is a happy medium sufficiently circumscribed to restrain the vicious and dishonest, and yet liberal enough to afford relief to the innocent and injured! Thus, it will be seen that uniformity in the operation of the divorce laws, as a part of the marriage contract, is made necessary by the facility with which divorces are now "made easy, and without publicity." The cases where a husband or wife has abandoned home and family, and gone into a neighboring State to procure a divorce that could not be obtained at home, are so frequent and notorious, that the public conscience has ceased to be more shocked over such an occurrence than over a bank-president's embezzlement, or a willful murder. And yet society should be shocked to the very depths of humiliation, for the histories of the majority of such cases show that they are instigated by the basest motives of the human heart. For some fancied or real grievance that could easily be explained by love, or remedied by law; for the slightest incompatibility that could exist between any two independent individuals, and which might be softened by intelligent forbearance, but which must be endured by all under any form of contract; or, from a sensual desire to form another marriage relation, or for apparent causes that have no deeper root of evil than fashionable folly, petty jealousy, and irritability of temper—the laws of many of the States offer a way for the dissolution of the marriage contract. It is, however, to the credit of our humanity that the noble and enduring men and women of our race—those upon whom the world must ever rely for the true advancement of man toward social perfection and individual happiness—seldom or never resort to the courts, even of their own State, for release from a contract which may have become onerous or even disgraceful to bear. Under the present liberal laws, regulating the relation of husband and wife, in some of the more progressive States, the parties stand so nearly equal before the law as individuals, in their personal and property rights, that there can not be the same excuses for resorting to divorce as a remedy for a real or supposed wrong, and certainly not the necessity for the assignment of so many statutory causes, as in former years. And while there should be other causes than adultery assigned for divorce, there is no other cause by which the family and society can be so deeply injured; no other cause that might not be adjusted between the parties, or removed by law, the same as if the marriage relation did not exist, or for which the innocent party might not suffer just as severely in his or her relation to society as in the relation of husband or wife.

Although New York has experimented with both a prohibitory and a liberal policy of divorce, long years of experience have demonstrated that the peace and happiness of the family and the purity of public morals are best subserved by a restrictive policy; yet no State in the Union can boast of a larger personal freedom of its citizens, or a higher standard of intelligence and morality. The percentage of illiteracy is comparatively small; woman is held in the highest esteem, and on all school questions has the equal right of suffrage; she is better protected in her personal and property rights than elsewhere; and, so far as the domestic relations are concerned, no State has a happier or a more contented people. The rural population is prosperous and happy in its Arcadian simplicity; and even in the great commercial metropolis of the State, where the opportunity for temptation and crime, corruption, and luxurious licentiousness, is so great, the intelligence and morals of the people are equal to those of any city in the world. Notwithstanding this, the laws of other States and the decisions of the courts make marriage in New York, as elsewhere, a contract subject to the caprice or dishonesty of either of the parties.

Parties who legally marry know the conditions of the contract into which they have entered. In New York they know that, as a part of the contract, so long as they reside in the State there is one cause only, except death, for its dissolution. And so long as one of the parties to a marriage continues to reside in the State in which the contract was made, and under the protection of its laws, no other State, into which the other party may have removed for the purpose of obtaining a divorce, should assume jurisdiction of the contract, or change its terms, so as to annul it for any other cause than that which existed in the State where the contract was made, and then only after obtaining personal service upon the non-resident defendant. It is questionable, as a matter of individual right, whether any State into which the parties may have mutually agreed to remove should assume jurisdiction to set aside the marriage contract for any other cause than could be assigned in the State in which the contract was made. Certainly one State should respect the laws of another, as it would have its own laws respected by the other. But the question of jurisdiction and domicile in interstate divorce has perplexed the courts almost endlessly. The general principle of law that the domicile of the wife remains with or follows the husband is limited by the reasons on which it rests, and must be varied according to the circumstances of the case, so that for the purpose of divorce each party is said to have a separate domicile. When one of the parties removes into another State for the purpose of divorce, and, after gaining a legal residence there, commences proceedings for divorce, how can the court, if marriage is a contract, get personal service upon the defendant so as to affect the rights of this non-resident party? Or, if marriage is a status, and the court takes cognizance only of the condition of the plaintiff, *it*, the condition of

the plaintiff, being within the jurisdiction of the court, why is it necessary to bring the non-resident party into court even by constructive service? Divorce in either case will not change the relation of the non-resident party to the laws of the State in which he or she resides; it might, if it were the woman who obtained the divorce, leave the husband a married man without a wife, or, if it were he who obtained the divorce, leave her a married woman without a husband; and if the one thus left should marry again, though the marriage should be held legal, he or she might be punished under the laws of the State for bigamy or adultery. Such is the right of sovereignty each State has over its own subjects. But no State should take jurisdiction to dissolve a marriage contract between parties not situated in a way to render the sentence of dissolution binding, on general principles of law, upon every other State. Yet it is so often done that the cases in one State to set aside divorces obtained in another State are notoriously frequent. There is no subject so intermixed with so much legal rubbish and confusion, none in relation to which there is so much diversity of law and judicial conflict and uncertainty, as that relating to marriage, whether considered as a contract or a status, and none to which the statesman should more earnestly address himself to relieve it of these absurd legal perplexities. But how can uniformity be attained after so many long years of confusion?

Congress should pass a law establishing uniform rules of marriage and divorce throughout the United States. It should declare that the marriage contract is of that kind within the meaning of the Constitution which declares that "no State shall pass any law impairing the obligation of contracts." Where both the parties are domiciled in the same State, it should leave them subject to the laws of the State in which they reside; but, when they become "citizens of different States" for the purpose of divorce, it should require the suit to be brought in the United States courts; and perhaps when woman, as a citizen, becomes co-equal with man before the law, it will in such cases be obliged to do so. This would give the courts jurisdiction of both parties, or the status of both parties, without resorting to legal subterfuge or fiction; and would, where the suit was between "citizens of different States," preserve the individual sovereignty and dignity of the two States. It would also harmonize the foregoing provision of the Constitution which declares that "no State shall pass any law impairing the obligation of contracts," with the provision which also declares that "full faith and credit shall be given in each State to the *public acts*, records, and judicial proceedings of every other State"—a harmony that has never heretofore existed. The obligation to give "full faith and credit" to the "public acts" and "judicial proceedings" of a State is reciprocal between States; how then, when the "public acts" of two States are in conflict on the subject of divorce, can one State, in a judicial proceeding by a resident of

its own, determine the relation of a citizen of another State to *its laws?* How can it impair the obligation of a contract or annul a status between parties, over one of whom it has no jurisdiction, and at the same time give "full faith and credit" to the "public acts" of the other State?

That Congress has the constitutional power to pass a law establishing uniform rules of marriage and divorce in the District of Columbia and all the Territories of the United States is beyond question. That it has not the power to pass a law establishing such rules throughout the United States can only be asserted. "Congress shall have power to establish a uniform rule of naturalization and uniform *laws* on the subject of *bankruptcies* throughout the United States"; and who can conceive of a person being more of a bankrupt in home and fortune than one who has a faithless wife or husband? Certainly in that view, with the marriage declared a contract within the meaning of the Constitution and its violation a species of bankruptcy, a general bankrupt law might give the courts jurisdiction to relieve a faithful husband or dutiful wife of the onerous conditions of a contract by the assignment of such assets as a worthless wife or husband to a generous and forgiving public.

There is another mode by which uniformity in the marriage and divorce laws of the States might be attained, whether the opinions of the judiciary could ever be harmonized or not, and that without impinging on the delicate question of State rights. Let Congress appoint commissioners to prepare a code of marriage and divorce laws for the District of Columbia and Territories of the United States, and invite each of the States to appoint a commissioner in its own behalf to unite with the commissioners appointed by Congress in forming a commission to codify and prepare a system of marriage and divorce, which, when passed by Congress and adopted by the several States, or any of them, shall have a uniform operation in the District of Columbia and Territories, and throughout the United States, or in those States adopting it. That there is an urgent necessity for Congress alone, or for Congress and the States united, to move earnestly in this matter, is not only seen in the ineffectual efforts of Congress every year to suppress polygamy, which is fast spreading from Utah into the other Territories, but also in an almost similar condition of society in the States, brought about by the ununiform laws and the conflicting decisions of the courts.

It is discreditable to civilization not to reverse a decision or principle of law, though of long standing, which is more evil in its continuance than inconvenient in its reversal or repeal. A thing which has outlived its influence for good, or a principle that has no longer an application to the progress of the age, in religion or law, should be abandoned. The spirit of the Constitution and the principles of interstate jurisdiction adjudicated under it have been insidiously directed,

since the foundation of the government, to the national protection of and non-interference with a local institution which no longer exists. The reasons upon which those principles were based and the status in whose interest the decisions were formulated into law having passed away, it is time that the judicial mind should readjust itself to the demands of a newer condition of life and a higher civilization. But the conservative judicial mind is the last *phase of energy* in which the theory of evolution evolves, and "general principles of law" handed down by judicial prejudice from generation to generation are the last to give way in matters of progress and reform, not only when the reasons on which they were based no longer exist, but when other and better reasons demand a change.

There is another phase of this question which assumes a peculiar interest at the present time. It is that the marriageable portion of seven eighths of the citizens of the United States is interdicted from intermarrying with any one of the marriageable portion of the other one eighth of the citizens. Not that any one of the marriageable portion of the seven eighths, or of the one eighth, competent to contract marriage, is prohibited from marrying; but if love, admiration, pecuniary interest, or convenience, should move one of the marriageable portion of the seven eighths to desire in marriage one of the marriageable portion of the one eighth who reciprocates the love, admiration, pecuniary interest, or convenience of the other, the law interferes and makes such marriage a criminal offense! Why? Because of a prejudice held by the seven eighths against the one eighth—held for the reason that all of the one eighth are related in a near or remote degree to a race that was for centuries held as slaves to the other. It is a prejudice, not so much against "color" as against "previous condition"—color being a legal designation to identify the individual with the proscribed race.

Marriage is a natural right into which the question of color does not enter except as an individual preference expressed by the parties to the marriage. It is so recognized by the laws of all nations except our own, though in a few States this natural right is now acknowledged by statute law. In Ohio the statute declares that "a person of *pure white* blood, who intermarries with any negro, or person having a distinct and visible admixture of African blood, and any negro or person having a distinct and visible admixture of African blood, who intermarries with any person of *pure white* blood, shall be fined not more than one hundred dollars, or imprisoned not more than three months, or both." And the judge who knowingly issues the license and the person who knowingly solemnizes the marriage are subject to the same penalties. It is possible, however, on the common-law principle, that a marriage of this kind, followed by the parties living together as man and wife, would be held valid, though they would be subject to the penalties of the law. But in a number of other States—mostly

Southern—such a marriage is declared absolutely void, and the parties living together under it are punishable by imprisonment in the penitentiary for "lascivious cohabitation." In these States the international and interstate rule, that a marriage legally contracted in one State is valid in every other State, is outraged and defied; and parties lawfully married in a State which does not prohibit the intermarriage of white and colored persons removing into these States are not recognized as husband and wife, but are made subjects of a law punishing fornication and adultery.

Before emancipation there was no legal marriage between slaves—a slave not being competent to enter into a contract—so that the relation of husband and wife depended wholly upon the will and caprice of the master. And the children of such marriages were neither legitimate nor illegitimate, coming into the world independent of all marriage laws. For this reason it would have been illogical in those States to have made it a penal offense for a white man and a slave woman, either through love, lustful passion, or desire of increase of property, to beget children of mixed white and colored blood, though the large numbers of persons of mixed color in the Southern States show that it was practiced to a profitable degree. But since the conditions of slavery have ceased to exist, and the freedmen have become citizens of the United States, endowed by the Constitution with all the political and civil rights enjoyed by their former masters, including the natural right of marriage, the reasons upon which the former black laws were based can have no application to the present social rights of these people. Still, the prejudice, deeply rooted in the interest of slavery, exists; and the cases recently before the Supreme Court under the civil-rights law, to test the constitutionality of the State laws punishing marriage between white and colored persons, have been decided on collateral issues in favor of that prejudice. Thus the laws of several States and the ruling of the highest tribunal in the land interrupt the natural law of selection and development. But the question is not at rest; it must be met—met as it now is, and as it will appear in the future. And if those States and the courts will not respond to the demands of the higher civilization of the age which recognizes this fundamental social law, Congress should clearly recognize and define the equal married rights of the citizens of the United States in the District of Columbia and the Territories, without regard to "race, color, or previous condition of servitude."

According to the last census, the population of the United States is reported at fifty millions, in round numbers. The report is very exact in giving the age, sex, and place of birth of each individual, native and foreign, and much other information valuable to the student of ethnology and the migration of peoples. But it is neglectful of one of the most important questions of races. It divides the population into two races, "white" and "colored," giving the number of the former

at over forty-three millions, and the number of the latter at over six millions; and, in every reference to the distribution of population for causes, it fails to distinguish between the black negro and colored white, but includes them as one. It fails to tell how many of the six millions of "colored" are of pure negro blood, how many are mulattoes, quadroons, octoroons, or of a less degree than pure white. It fails to tell how many of the mixed blood are of pure white fathers, or pure white mothers—information necessary for the prediction of the future progress, endurance, and social position of the "colored race." This neglect, both in the last and preceding census reports, if not willful, is not creditable to the science side of our Government.

Before the war, citizenship was qualified by the word "white" in the Constitutions of the several States, but there was no uniformity in the definition of the word. Some States held that a person who had more white blood than black blood in his veins was white within the meaning of their Constitutions. Other States held that a person who had less than three fourths or seven eighths of white blood was black, and still other States held that anything less than pure white was black. But since the adoption of the fourteenth amendment, which declares that "all persons born or naturalized in the United States are citizens of the United States and the State in which they reside," and that "no State shall make or enforce any law which shall abridge the privileges or immunities of citizens of the United States," this qualification of citizenship by the word "white" has no application, so far as the civil and political rights of the citizen are concerned. Nevertheless, wherever the law affects the social or semi-social relations of the citizen, his rights are qualified, and the word white excludes from the equal privileges and protection of the law all citizens having the least particle of colored blood in their veins. In one of the recent civil-rights cases decided by the Supreme Court—a case of the marriage of a white woman with a colored man—the court held that the State law punishing the parties was not in conflict with the fourteenth amendment, or with the civil-rights law founded on it, for the reason that the State law applies the same punishment to both offenders, the white and the black, without distinction! True, the punishment was equal without distinction of color, as it would have been in a case of larceny. But the law in prohibiting the marriage could not be constitutional, because it abridges the privileges of the citizen on account of color; it denies to the colored male citizen the equal privilege and protection of the law extended to the white male citizen—the right to marry a white woman. It also denies the white female citizen the equal privilege and protection of the law granted the colored female citizen—the right to marry a colored man.

However much the prejudice of the law and the courts may give an enforced unity to the negro race and the "colored whites," there is no ignoring the physical fact that a person who is seven eighths white,

or who is but one thirty-second part colored, is not black. Of the six millions of blacks, "black" according to the United States census and the decisions of the courts, perhaps nearly two millions are of a mixed color, more white than black. Many of them are descendants of the most distinguished white blood in the history of the nation. To what race do they belong? By State laws and the decision of the Supreme Court they belong to the negro or the American-African race. By the law of nature they belong, either to the Anglo-American race, or are a race within themselves. It is no longer a doubtful question; their constant increase in numbers shows that they are engenesic, and capable of maintaining within themselves a race of their own. Can such a people as this mixed race, imbued with the instincts, capabilities, and ambitions common to their white blood, be forever thrust back upon the negro race? Is the race-conflict so irrepressible in this country that they can not ever be merged in the white race? Or is it wiser for science and the law to recognize, in the process of the formation of races, that they are strictly a distinct and intermediate race? Already, in proportion to numbers, as many of them stand as high in intellectual development as white persons of the same class. And as the great mass of mankind, white and black, must ever be laborers and followers, and as all the avenues of trade and commerce, learning, culture, and civil and political distinctions, are open to all, this "mixed race" must eventually become sharp competitors for the supremacy in this country. What the result may be to this republic is a problem for the publicist, the scientist, and the statesman to solve.

EVOLUTION.

By H. H. BOYESEN.

I.

BROAD were the bases of all being laid
On pillars sunk in the unfathomed deep
Of universal void and primal sleep.
Some mighty will there was, in sooth, that swayed
The misty atoms which inhabited
The barren, unillumined fields of space;
A breath, perchance, that whirled the mists apace,
And shook the heavy indolence that weighed
Upon the moveless vapors. Oh, what vast,
Resounding undulations of effect
Awoke that breath! What dizzying æons passed
Ere yet a lichen-patch the bare rock flecked!
Thus rolls with boom of elemental strife
The ancestry e'en of the meanest life.

II.

I am the child of earth and air and sea!
My lullaby by hoarse Silurian storms
Was chanted; and through endless changing forms
Of plant and bird and beast unceasingly
The toiling ages wrought to fashion me.
Lo, these large ancestors have left a breath
Of their strong souls in mine, defying death
And change. I grow and blossom as the tree,
And ever feel the deep-delving earthy roots
Binding me daily to the common clay.
But with its airy impulse upward shoots
My life into the realms of light and day;
And thou, O Sea, stern mother of my soul,
Thy tempests sing in me, thy billows roll!

III.

A sacred kinship I would not forego
Binds me to all that breathes; through endless strife
The calm and deathless dignity of life
Unites each bleeding victim to its foe.
What life is in its essence, who doth know?
The iron chain that all creation girds
Encompassing myself and beasts and birds,
Forges its bond unceasing from below—
From water, stone, and plant, e'en unto man.
Within the rose a pulse that answered mine
(Though hushed and silently its life-tide ran)
I oft have felt; but when with joy divine
I hear the song-thrush warbling in my brain,
I glory in this vast creation's chain.

IV.

I stood and gazed with wonder blent with awe
Upon the giant footprints Nature left
Of her primeval march in yonder cleft;
A fern-leaf's airy woof, a reptile's claw,
In their eternal slumber there I saw
In deftly-wrought sarcophagi of stone.
What humid tempests, from rank forests blown,
Whirled from its parent stem yon slender straw?
What scaly creature of a monstrous breed
Bore yonder web-foot through the tepid tide?
Oh, what wide vistas thronged with mighty deed
And mightier thought have here mine eyes descried!—

Come, a fraternal grasp, thou hand of stone!
The flesh that once was thine is now mine own.

V.

Sublime is life, though in beginnings base
At first enkindled. In this clod of mold
Beats with faint spirit-pulse the heart of gold
That warms the lily's cheek; its silent grace
Dwells unborn 'neath this sod. Fain would I trace
The potent mystery which, like Midas' hand,
Thrills the mean clay into refulgence grand;
For, gazing down the misty aisles of space
And time, upon my sight vast visions throng
Of the imperial destiny of man.
The life that throbbed in plant and beast ere long
Will break still wider orbits in its van—
A race of peace-robed conquerors and kings,
Achieving evermore diviner things.

—*From "Idyls of Norway."*

THE BOUNDARIES OF ASTRONOMY.

II.

THE NEBULAR HYPOTHESIS.

By ROBERT S. BALL, F.R.S.,
ASTRONOMER-ROYAL OF IRELAND.

THE whole range of astronomy presents no speculations which have attracted more attention than the celebrated nebular hypotheses of Herschel and of Laplace. We shall first enunciate these speculations, and then we shall attempt to indicate how far they seem to be warranted by the actual state of scientific knowledge. In one of his most memorable papers, Sir William Herschel presents us with a summary of his observations on the nebulæ, arranged in such a manner as to suggest his theory of the gradual transmutation of nebulæ into stars. He first shows us that there are regions in the heavens where a faint diffused nebulosity is all that can be detected by the telescope. There are other nebulæ in which a nucleus can be just discerned; others again in which the nucleus is easily seen; and still others where the nucleus is a brilliant, star-like point. The transition from an object of this kind to a nebulous star is very natural, while the nebulous stars pass into the ordinary stars by a few graduated stages. It is thus possible to enumerate a series of objects, beginning at one end with the most diffused nebulosity, and ending at the other with an ordinary

fixed star or group of stars. Each object in the series differs but slightly from the object just before it and just after it. It seemed to Herschel that he was thus able to view the actual changes by which masses of phosphorescent or glowing vapor became actually condensed down into stars. The condensation of a nebula could be followed in the same manner as we can study the growth of the trees in a forest by comparing the trees of various ages which the forest contains at the same time. In attempting to pronounce upon the positive evidence available in the discussion of Herschel's theory, we encounter a well-known difficulty. To establish this theory, it would be necessary to watch the actual condensation of one single nebula from the primitive gaseous condition down to the stellar points. It may easily be conceived that such a process would require a vast lapse of time, perhaps enormously greater than the period between the invention of the telescope and the present moment. It may at all events be confidently asserted that the condensation of a nebula into a star is a process which has never been witnessed. Whether any stages in that process can be said to have been witnessed is a different matter, on which it is not easy to speak with precision. Drawings of the same nebula, made at different dates, often exhibit great discrepancies. In comparing these drawings, it must be remembered that a nebula is an object usually devoid of distinct outline, and varying greatly in appearance with different telescopic apertures. Take, for instance, the very splendid nebula in Orion, which is one of the most glorious objects that can be seen in a telescope. There can be no doubt that the drawings made at different times do exhibit most marked differences. Indeed, the differences are sometimes so great that it is hard to believe that the same object is depicted. It is well to look also at drawings made of the same object at the same time, but by different observers and with different telescopes. Where we find contemporary drawings at variance—and they are often widely at variance—it seems hard to draw any conclusion from drawings as to the presence or the absence of change in the shape of the nebula.

There are, however, good grounds for believing that nebulæ really do undergo some changes, at least as regards brightness; but whether these changes are such as Herschel's theory would seem to require is quite another question. Perhaps the best authenticated instance is that of the variable nebula in the constellation of Taurus, discovered by Mr. Hind in 1852. At the time of its discovery this object was a small nebula about one minute in diameter, with a central condensation of light. D'Arrest, the distinguished astronomer of Copenhagen, found, in 1861, that this nebula had vanished. On the 29th of December, 1861, the nebula was again seen in the powerful refractor at Pulkova, but, on December 12, 1863, Mr. Hind failed to detect the nebula with the telescope by which it had been originally discovered. This instrument had, however, only half the aperture of the Pulkova

telescope. In 1868, O. Struve, observing at Pulkova, detected another nebulous spot in the vicinity of the place of the missing object, but this has also now vanished. Struve does not, however, consider that the nebula of 1868 is distinct from Hind's nebula, but he says:

> What I see is certainly the variable nebula itself, only in altered brightness and spread over a larger space. Some traces of nebulosity are still to be seen exactly on the spot where Hind and D'Arrest placed the variable nebula. It is a remarkable circumstance that this nebula is in the vicinity of a variable star, which changes somewhat irregularly from the ninth to the twelfth magnitude. At the time of the discovery, in 1861, both the star and the nebula were brighter than they have since become.

This is the best authenticated history of observed change in any nebula. It must be admitted that the changes are such as would not be expected if Herschel's theory were universally true.

Another remarkable occurrence in modern astronomy may be cited as having some bearing on the question as to the actual evidence for or against Herschel's theory. On November 24, 1876, Dr. Schmidt noticed a new star of the third magnitude, in the constellation Cygnus. The discoverer was confident that no corresponding object existed on the evening of the 20th of November. The brilliancy of the new star gradually declined, until, on the 13th of December, Mr. Hind found it of the sixth magnitude. The spectrum of this star was carefully studied by many observers, and it exhibited several bright lines, which indicated that the star differed from other stars by the possession of vast masses of glowing gaseous material. This star was observed by Dr. Copeland, at the Earl of Crawford's observatory, on September 2, 1877. It was then below the tenth magnitude, and of a decidedly bluish tint. Viewed through the spectroscope, the light of this star was almost completely monochromatic, and appeared to be indistinguishable from that which is often found to come from nebulæ. Dr. Copeland thus concludes:

> Bearing in mind the history of this star from the time of its discovery by Schmidt, it would seem certain that we have an instance before us in which a star has changed into a planetary nebula of small angular diameter. At least it may be safely affirmed that no astronomer, discovering the object in its present state, would, after viewing it through a prism, hesitate to pronounce as to its present nebulous character.

It should, however, be added that Professor Pickering has since found slight traces of a continuous spectrum, but the object has now become so extremely faint that such observations are very difficult. This remarkable history might be adduced if we wished to procure evidence of the conversion of stars into nebulæ, but for the nebular theory we require evidence of the conversion of nebulæ into stars.

Care must be taken not to exaggerate the inferences to be drawn from the two instances I have quoted, viz., the variable nebula in Taurus and the new star in Cygnus. I think it more likely that both of

these are to be regarded as exceptional phenomena. It is certainly true that they are perhaps the most remarkable instances in which changes in nebulæ have actually been witnessed; but the probability is that the only reason why they have been witnessed is because they were very exceptional. Those who have observed the nebulæ for many years are well assured of the general permanence of their appearance. The nebulæ we have referred to are chosen out of thousands. The ordinary nebulæ appear just as constant as the ordinary bright stars. Every one expects to see Vega in the constellation Lyra; and with equal confidence every astronomer counts on seeing the celebrated annular nebula when he directs his telescope to the same constellation. This permanence is very probably merely due to the stupendous distances at which these objects are placed. Only gigantic changes could be detected, and for these, gigantic periods of time would be required. We are bound to believe that heated bodies radiate their heat; and, if so, they must contract. This general law, which pervades all Nature, so far as we know it, seems to be the real basis—indeed, the only basis—on which the nebular theory of Herschel can be maintained. Up to the present, it must be admitted that this theory has received no direct telescopic confirmation.

The nebular theory by which Laplace sought to account for the origin of the solar system seems, from the nature of the case, to be almost incapable of receiving any direct testimony. We shall here enunciate the theory in the language of Professor Newcomb:

The remarkable uniformity among the directions of the revolutions of the planets being something which could not have been the result of chance, Laplace sought to investigate its probable cause. This cause, he thought, could be nothing else than the atmosphere of the sun, which once extended so far out as to fill all the space now occupied by the planets. He conceives the immense vaporous mass forming the sun and his atmosphere to have had a slow rotation on its axis. The mass, being intensely hot, would slowly cool off, and as it did so would contract toward the center. As it contracted, its velocity would, in obedience to one of the fundamental laws of mechanics, constantly increase, so that a time would arrive when, at the outer boundary of the mass, the centrifugal force due to the rotation would counterbalance the attractive force of the central mass. Then those outer portions would be left behind as a revolving ring, while the next inner portions would continue to contract, until at their boundary the centrifugal and attractive forces would be again balanced, when a second ring would be left behind, and so on. Thus, instead of a continuous atmosphere, the sun would be surrounded by a series of concentric revolving rings of vapor.

Now, how would these rings of vapor behave? As they cooled off, their denser materials would condense first, and thus the ring would be composed of a mixed mass, partly solid and partly vaporous, the quantity of solid matter constantly increasing and that of vapor diminishing. If the ring were perfectly uniform this condensing process would take place equally all around it, and the ring would thus be broken up into a group of small planets like that which we see between Mars and Jupiter. But we should expect that, in general, some

portions of the ring would be much denser than others, and the denser portion would gradually attract the rarer portions around it, until instead of a ring we should have a single mass, composed of a nearly solid center, surrounded by an immense atmosphere of fiery vapor. This condensation of the ring of vapor around a single point would have produced no change in the amount of rotary motion originally existing in the ring; the planet surrounded by its fiery atmosphere would therefore be in rotation, and would be, in miniature, a reproduction of the case of the sun surrounded by his atmosphere with which we set out. In the same way that the solar atmosphere formed itself first into rings, and then these rings condensed into planets, so, if the planetary atmosphere were sufficiently extensive, they would form themselves into rings, and these rings would condense into satellites. In the case of Saturn, however, one of the rings was so perfectly uniform that there could be no denser portion to draw the rest of the ring around it, and thus we have the well-known rings of Saturn.

It will thus be seen that one of the principal features in the solar system for which the nebular theory has been invoked is the fact that the planets all revolve round the sun in the same direction. It will therefore be natural to take up first the discussion of this subject, and to inquire how far the common motion of the planets can be claimed in support of Laplace's nebular theory. The value of this argument is very materially influenced by another consideration of a somewhat peculiar character. If it were quite immaterial to the welfare of the planetary system whether all the planets moved the same way, or whether some moved one way and some another, then the nebular hypothesis would be entitled to all the support which could be derived from the circumstances of the case. Take, for instance, the eight principal planets—Mercury, Venus, the Earth, Mars, Jupiter, Saturn, Uranus, Neptune. All these planets move in the same way around the sun. The chances against such an occurrence are 127 to 1. The probability that the system of eight planets have been guided to move in the same direction by some cause may be taken to be 127 to 1. If we include the two hundred minor planets, the probability would be enormously enhanced. The nebular theory seems a reasonable explanation of how this uniformity of movements could arise, and therefore the advocates of the nebular theory may seem entitled to claim all this high degree of probability in their favor. There is, however, quite a different point of view from which the question may be regarded. There are reasons which imperatively demand that the planets (at all events the large planets) shall revolve in uniform directions, which lie quite outside the view taken in the nebular theory. If the big planets did not all revolve in the same direction, the system would have perished long ago, and we should not now be here to discuss the nebular or any other hypothesis.

It is well known that, in consequence of the gravitation which pervades the solar system, each of the planets has its movements mainly subordinated to the attraction of the sun. But each of the planets attracts every other planet. In consequence of these attractions the

orbits of the planets are to some extent affected. The mutual actions of the planets present many problems of the highest interest, and, it should be added, of the greatest difficulty. Many of these difficulties have been overcome. It is the great glory of the French mathematicians to have invented the methods by which the nature of the solar system could be studied. The results at which they arrived are not a little remarkable. They have computed how much the planets act and react upon each other, and they have shown that in consequence of these actions the orbit of each planet gradually changes its shape and its position. But the crowning feature of these discoveries is the demonstration that these changes in the orbits of the planets are all periodic. The orbits may fluctuate, but those fluctuations are confined within very narrow limits. In the course of ages the system gradually becomes deformed, but it will gradually return again to its original position, and again depart therefrom. These changes are comparatively so small that our system may be regarded as substantially the same even when its fluctuations have attained their greatest amplitude. These splendid discoveries are founded upon the actual circumstances of the system, as we see that system to be constituted. Take, for instance, the eccentricities of the orbits of the planets around the sun. Those eccentricities can never change much; they are now small quantities, and small quantities those eccentricities must forever remain. The proof of this remarkable theorem partly depends upon the fact that the planets are all revolving around the sun in the same direction. If one of the planets we have named were revolving in an opposite direction to the rest, the mathematical theory would break down. We would have no guarantee that the eccentricities would forever remain small as they are at present. In a similar manner, the planets all move in orbits whose planes are inclined to each other at very small angles. The positions of those planes fluctuate, but these fluctuations are confined within very narrow limits. The proof of this theorem, like the proof of the corresponding theorem about the eccentricities, depends upon the actual conditions of the planetary system as we find it. If one of the planets were to be stopped, turned round, and started off again in the opposite direction, our guarantee for the preservation of the planes would be gone. It therefore follows that, if the system is to be permanently maintained, all the planets must revolve in the same direction.

In this connection it is impossible not to notice the peculiar circumstances presented by the comets. By a sort of convention, the planets have adopted, or, at all events, they possess, movements which fulfill the conditions necessary if the planets are to live and let live; but the comets do not obey any of the conditions which are imposed by the planetary convention. The orbits of the comets are not nearly circles. They are sometimes ellipses with a very high degree of eccentricity; they are often so very eccentric that we are unable to dis-

tinguish the parts of their orbits which we see from actual parabolas. Nor do the directions in which the comets move exhibit any uniformity; some move round the sun in one direction, some move in the opposite direction. Even the planes which contain the orbits of the comets are totally different from each other. Instead of being inclined at only a very few degrees to their mean position, the planes of the comets hardly follow any common law; they are inclined at all sorts of directions. In no respect do the comets obey those principles which are necessary to prevent constitutional disorder in the planetary system. The consequences of this are obvious, and unfortunate in the highest degree—for the comets. A comet possesses no security for the undisturbed enjoyment of its orbit. Not to mention the risk of actual collision with the planets, there are other ways in which the path of a comet may experience enormously great changes by the disturbances which the planets are capable of producing. How is it that the system has been able to tolerate the vagaries of comets for so many ages? Solely because the comets, though capable of suffering from perturbations, are practically incapable of producing any perturbations on the planets. The efficiency of a body in producing perturbations depends upon the mass of the body. Now, all we have hitherto seen with regard to comets tends to show that the masses of comets are extremely small. Attempts have been made to measure the masses of comets. Those attempts have always failed. They have failed because the scales in which we have attempted to weigh the comets have been too coarse to weigh anything of the almost spiritual texture of a comet. It is unnecessary to go as far as some have done, and to say that the weight of a large comet may be only a few pounds or a few ounces. It might be more reasonable to suppose that the weight of a large comet was thousands of tons, though even thousands of tons would be far too small a weight to admit of being measured by the very coarse balance which is at our disposal.

The enduring stability of the planetary system is thus seen to be compatible with the existence of comets solely because comets fulfill the condition of being almost imponderable in comparison with the mighty masses of the planetary system. The very existence of our planetary system is a proof of the doctrine that the masses of the comets are but small. Indeed, to those who will duly weigh the matter, it will probably appear that this negative evidence as to the mass of the comets is more satisfactory than the results of any of the more direct attempts to place the comets in the weighing-scales. If we restate the circumstances of the solar system, and if we include the comets in our view, it will appear how seriously the existence of the comets affects the validity of the argument in favor of the nebular hypothesis which is derived from the uniformity in the directions of the planetary movements. If we include the whole host of minor planets, we have for the population of the solar system something

under three hundred planets, and an enormous multitude of comets. It will probably not be an overestimate if we suppose that the comets are ten times as numerous as the planets. The case, then, stands thus: The solar system consists of some thousands of different bodies; these bodies move in orbits of the most varied degrees of eccentricity; they have no common direction; their planes are situated in all conceivable positions, save only that each of these planes must pass through the sun. Stated in this way, the present condition of the solar system is surely no argument for the nebular theory. It might rather be said that it is inconceivable on the nebular theory how a system of this form could be constructed at all. Nine tenths of the bodies in the solar system do not exhibit movements which would suggest that they were produced from a nebula: the remaining tenth do no doubt exhibit movements which seem to admit of explanation by the nebular theory; but, had that tenth not obeyed the group of laws referred to, they would not now be there to tell the tale. The planetary system now lives solely because it was an organism fitted for survival. It is often alleged that the comets are not indigenous to the solar system. It has been supposed that the comets have been imported from other systems. It has also been urged with considerable probability that perhaps many comets may have had their origin in our sun and have been actually ejected therefrom. I do not now attempt to enter into the discussion of these views, which are at present problematical; let me pass from this part of the subject, with the remark that, until the nature and origin of comets be better understood, it will be impossible to appraise with accuracy the value of the argument for the nebular hypothesis which has been based on the uniformity of the directions in which the planets revolve around the sun.

There are, however, other circumstances in the solar system which admit of explanation by the nebular theory. It is a remarkable fact that the Earth, Mars, Jupiter, and Saturn are all known to rotate upon their axes in the same direction as their revolutions around the sun. The nebular theory offers an explanation of this circumstance. It does not appear that this common rotation of the planets is absolutely necessary for the stability of the system. Should it further be proved that there is no other agency at work which would force the planets to rotate in the same direction, then it must be admitted that the nebular theory receives very substantial support.

There is another way in which we can examine the evidence on behalf of the nebular hypothesis. There are certain actions going on at present in the solar system; and by reasoning backward from these present actions we are led to believe that in extremely early times the condition of things may have resembled that which is supposed by the nebular hypothesis. Let us begin with the consideration of our sun, which is, as we know, daily radiating off light and heat into space. This heat is poured off in all directions; a small portion

of it is intercepted by the earth, but this portion is less than one two-thousand-millionth part of the whole; the planets also, no doubt, each intercept a small portion of the solar radiation; but the great mass of radiated heat from the sun entirely escapes. This heat is supposed not to be restored to the sun. The sun certainly must receive some heat by the radiation from the stars; but this is quite infinitesimal in comparison with the stupendous radiation from the sun. We therefore conclude that the sun's heat is being squandered with prodigal liberality.* We also know that the store of heat which the sun can possess, though no doubt enormously great, is still limited in amount. It is, indeed, a question of very great interest to decide what are the probable sources by which the sun is able to maintain its present rate of expenditure. The sun must have some source of heat in addition to that which it would possess in virtue of its temperature as an incandescent body. If we suppose the sun to be a vast incandescent body, formed of materials which possess the same specific heat as the materials of which our earth is composed, the sun would then cool at the rate of from 5° to 10° per annum. At this rate the sun could not have lasted for more than a few thousand years before it cooled down. We are therefore compelled to inquire whether the sun may not have some other source of heat to supply its radiation beyond that which arises merely from the temperature.

Of the various sources which have been suggested, it will here only be necessary to mention two. It has been supposed that the heat of the sun may be recruited by the incessant falling of meteoric matter upon the sun's surface. If that matter had been drawn only by the sun's attraction from the remote depths of space, it would fall upon the sun with an enormously great velocity, amounting to about 300 miles a second. It follows from the principle of the equivalence between heat and mechanical energy that a body entering the sun with this velocity would contribute to the sun a considerable quantity of heat. It is known that small meteoroids abound in the solar system; they are constantly seen in the form of shooting-stars when they dash into our atmosphere, and it can hardly be doubted that myriads of such bodies must fall into the sun. It does not, however, seem likely that enough matter of this kind can enter the sun to account for its mighty radiation of heat. It can be shown that the quantity of matter necessary for this purpose is so large that a mass equal in the aggregate to the mass of the earth would have to fall into the sun every century if the radiation of the sun were to be defrayed from this source. That so large a stream of matter should be perennially drawn into the sun is, to say the least, highly improbable. But it is

* A remarkable theory has recently been put forward by Dr. Siemens, according to which the sun's radiant energy is ultimately restored to the sun. Even the possibility of some such theory being true most seriously affects the above arguments in favor of the nebular hypothesis.

quite possible to account for the radiation of the sun on strictly scientific principles, even if we discard entirely the contributions due to meteoric matter. As the sun parts with its heat it must contract, in virtue of the general law that all bodies contract when cooling; but in the act of contraction an amount of heat is produced. By this the process of cooling is greatly retarded. It can, indeed, be shown that, if the sun contracts so that his diameter decreases one mile every twenty-five years, the amount of heat necessary to supply his radiation would be amply accounted for. At this rate many thousands of years must elapse before the diminution in the sun's diameter would be large enough to be appreciable by our measurements.

Looking back into the remote ages, we thus see that the sun was larger and larger the further back we project our view. If we go sufficiently far back, we seem to come to a time when the sun, in a more or less completely gaseous state, filled up the whole solar system out to the orbit of Mercury, or earlier still, out to the orbit of the remotest planet. If we admit that the present laws of Nature have been acting during the past ages to which we refer, then it does not seem possible to escape the conclusion that the sun was once a nebulous mass of gas such as the nebular theory of Laplace would require.

It will also throw some light upon this retrospective argument for the nebular theory if we briefly consider the probable past history of the earth. It is known that the interior of the earth is hotter than the exterior. It has been suggested that this interior heat may arise from certain chemical actions which are at present going on. If this were universally the case, the argument now to be brought forward could not be entertained. I believe, however, most physicists will agree in thinking that the interior heat of the earth is an indication that the earth is cooling down from some former condition in which it was hotter than it is at present. The surface has cooled already, and the interior is cooling as quickly as the badly conducting materials of the earth will permit. We are thus led to think of the earth as having been hotter in past time than at present. The further we look back the greater must the earth's heat have been. We can not stop till the earth was once red-hot or white-hot, till it was molten or a mass of fiery vapor. Here, again, we are led to a condition of things which would certainly seem to harmonize with the doctrines of the nebular theory.

The verdict of science on the whole subject can not be expressed better than in the words of Newcomb:

> At the present time we can only say that the nebular hypothesis is indicated by the general tendencies of the laws of Nature; that it has not been proved to be inconsistent with any fact; that it is almost a necessary consequence of the only theory by which we can account for the origin and conservation of the sun's heat; but that it rests on the assumption that this conservation is to be explained by the laws of Nature as we now see them in operation.

Should any one be skeptical as to the sufficiency of these laws to account for the present state of things, science can furnish no evidence strong enough to overthrow his doubts until the sun shall be found growing smaller by actual measurement, or the nebulæ be actually seen to condense into stars and systems.

DARWIN AND COPERNICUS.*

By Professor E. DU BOIS-REYMOND.

THE losses by death which natural science has sustained during the past year are unusually heavy. The fertile and ingenious mathematician who for more than a generation held a leading position among French men of science as the publisher of one of the best-known mathematical journals; the chemist who, by the first organic synthesis, helped to dispel the illusion of vital energy; the physiologist who solved one of the oldest problems of humanity—are men whose death leaves a void not easily filled up. But the luster of even such names as Liouville, Wöhler, and Bischoff pales before that of the first on our list, Charles Darwin. Nearly every learned society in existence has publicly deplored his loss. As this Academy has not hitherto found a fitting opportunity for doing so, it is necessary to add a few words to the formal mention of his decease, to show that we also appreciate the greatness of the man and of the loss science has sustained in him.

To say anything fresh concerning him will only be possible when the lapse of time and the progress of science have opened up new points of view; and the speaker, who has often had occasion to discuss Darwin before this Academy, finds it especially difficult not to repeat himself, the more so as opinions of his work are still somewhat apt to be influenced by personal feeling.

Darwin seems to me to be the Copernicus of the organic world. In the sixteenth century Copernicus put an end to the anthropocentric theory by doing away with the Ptolemaic spheres and bringing our earth down to the rank of an insignificant planet. At the same time he proved the non-existence of the so-called empyrean, the supposed abode of the heavenly hosts, beyond the seventh sphere, although Giordano Bruno was the first who actually drew the inference.

Man, however, still stood apart from the rest of animated beings—not at the top of the scale, his proper place, but quite away, as a being absolutely incommensurable with them. One hundred years later Descartes still held that man alone had a soul, and that beasts were mere automata. Notwithstanding all the labor of naturalists since the days of Linnæus, notwithstanding the resurrection of vanished genera and species by Cuvier, the theory of the origin and interdependence of

* Address delivered at the anniversary meeting of the Berlin Academy of Sciences.

living things, which was almost universal five-and-twenty years ago, was only equaled in arbitrariness, artificiality, and absurdity by the celebrated theory of Epicycles, which caused Alfonso of Castile to exclaim, "If God had asked my advice when he created the world, I should have managed things much better."

"*Afflavit Darwinius et dissipata est*," would, alluding to the above-mentioned theory, be a fitting inscription for a medal in honor of the "Origin of Species." For now all things were seen to be due to the quiet development of a few simple germs; graduated days of creation gave place to one day on which matter in motion was created; and organic suitability was replaced by a mechanical process, for as such we may look on natural selection, and now for the first time man took his proper place at the head of his brethren.

We may compare Copernicus's student-days at Bologna with Darwin's voyage in the Beagle, and his retired life at Frauenburg with Darwin's in his Kentish home, up to the time when the appearance of Mr. Wallace's work caused him to break his long silence. Here, happily for Darwin, the parallel ends. Many circumstances combined in Darwin's case to render his task easier and insure his ultimate triumph. Botany and zoölogy, morphology, the theory of evolution, and the study of the geographical distribution of plants and animals, had advanced far enough to allow of general conclusions being drawn from them; Lyell's sound sense had freed geology from the hypotheses which disfigured it, and introduced the idea of uniformity into science. The doctrine of the conservation of energy had been put on a new basis, and extended so that in combination with astronomical observation it gave rise to entirely new views of the history and duration of the universe. The doctrine of vital energy had been proved to be untenable on closer investigation. An unusually dry season had some years earlier led to the discovery of the so-called lake-dwellings in the bed of one of the Swiss lakes, whereby prehistoric research was quickly extended and developed. Though many links are still missing, we may fairly consider the knowledge of the existence of primeval man as the beginning of the long-looked-for connection between him and the anthropoids on the one hand, and between them both and their common progenitors on the other. In a word, the time had come for the publication of the "Descent of Man"; that is why an opinion on the nature of man, which differs from all former ones fully as much as the system of Copernicus, of which it is the complement, differs from that of Ptolemy, found such ready and general acceptance.

How different was the fate of Copernicus! "Copernicus," says Poggendorff, "is, and will ever remain, a brilliant star in the firmament of science; but he rose at a time when the horizon was almost entirely obscured by the mists of ignorance. . . . The Ptolemaic system was too ancient and too much venerated to be easily displaced." Copernicus's teaching met with but scant appreciation for the first

fifty years after its publication; even Tycho Brahe opposed it; it can therefore scarcely cause surprise that Luther rejected it, that Giordano Bruno died at the stake for his advocacy of it, while the less steadfast Galileo was forced to renounce it.

Notwithstanding the pessimism of our speculative philosophers, who deny all progress because they contribute nothing toward it, Darwin's lot was happier than that of the great reformer of astronomy. While Copernicus could only feast his eyes on the first printed copy of his work as he lay on his death-bed, because he had not dared to publish it sooner, although he had completed it some years before, Darwin survived the appearance of his nearly a quarter of a century. He witnessed the fierce struggles its appearance at first gave rise to; its ever-increasing acceptance and its final triumph, to which he, cheerful and active to the last, greatly contributed by a long series of admirable works.

While the Holy Inquisition persecuted the followers of Copernicus with fire and sword, Charles Darwin lies buried in Westminster Abbey among his peers, Newton and Faraday.

WHISTLING.

By T. F. THISELTON DYER.

IN whatever way regarded, either as a graceful accomplishment or as the spontaneous expression of light-heartedness, whistling has in our own and foreign countries generally attracted considerable attention. Why it should have been invested with so much superstitious awe it is difficult to say, but it is a curious fact that the same antipathy which it arouses among certain classes of our own countrymen is found existing in the most distant parts of the earth, where, as yet, civilization has made little or imperceptible progress. Thus Captain Burton * tells us how the Arabs dislike to hear a person whistle, called by them *el sifr*. Some maintain that the whistler's mouth is not to be purified for forty days; while, according to the explanation of others, Satan touching a man's body causes him to produce, what they consider, an offensive sound † The natives of the Tonga Islands, Polynesia, hold it to be wrong to whistle, as this act is thought to be disrespectful to God.‡ In Iceland, the villagers have the same objection to whistling, and so far do they carry their superstitious dread of it that "if one swings about him a stick, whip, wand, or aught that

* "First Footsteps in East Africa," 1856, p. 142.

† Carl Engel, "Musical Myths and Facts," 1876, i, 91.

‡ "Mariner and Martin: An Account of the Natives of the Tonga Islands," 1818, ii, 131.

makes a whistling sound, he scares from him the Holy Ghost"; while other Icelanders, who consider themselves free from superstitions, cautiously give the advice: "Do it not; for who knoweth what is in the air?" However eccentric these phases of superstitious belief may appear to us, yet it must not be forgotten that very similar notions prevail at the present day, in this country. A correspondent of "Notes and Queries" (1879, fifth series, xii, 92), for instance, relates how one day, after attempting in vain to get his dog to obey orders to come into the house, his wife tried to coax it by whistling, when she was suddenly interrupted by a servant, a Roman Catholic, who exclaimed in the most piteous accents, "If you please, ma'am, don't whistle—every time a woman whistles, the heart of the blessed Virgin bleeds!" In some districts of North Germany the villagers say that if one whistles in the evening it makes the angels weep. Speaking, however, of ladies in connection with whistling, it is a wide-spread superstition that it is at all times unlucky for them to whistle, which, according to one legend, originated in the circumstance that, while the nails for our Lord's cross were being forged, a woman stood by and whistled. Curiously enough, however, one very seldom hears any of the fair sex indulging in this recreation, although there is no reason, as it has been often pointed out, why they should not whistle with as much facility as the opposite sex. One cause, perhaps, of the absence of this custom among women may be, in a measure, due to the distortion of the features which it occasions. Thus we know how Minerva cast away, with an imprecation, the pipe, which afterward proved so fatal to Marsyas, when she beheld in the water the disfigurement of her face caused by her musical performance. There are numerous instances on record, nevertheless, of ladies whistling at public entertainments, and charming their audiences with the graceful ease with which they performed such airs as "The Blue Bells of Scotland" or "The Mocking-Bird." Indeed, not many years ago, at a grand provincial concert, two sisters excited much admiration by the clever and artistic way in which they whistled a duet.

Referring to whistling performances, Addison, in one of the earlier numbers of the "Spectator," gives an amusing account of a contest, where a prize of a guinea was to be conferred on the successful competitor who could not only whistle the best, but go through his tune without laughing, and that in spite of the ludicrous antics of a certain merry-andrew, whose special duty it was to try as far as possible to discompose each of the competitors by making grimaces. On the occasion in question, the competitors were an under-citizen, remarkable for his wisdom—a plowman endued "with a very promising aspect of inflexible stupidity"—and a footman, who, having captivated his audience by whistling "a Scotch tune and an Italian sonata," carried off the prize. Strutt, in his "Sports and Pastimes," relates the remarkable performance of a whistler, who, assuming the name of Rossignol,

exhibited at the end of the last century his talent on the stage of Covent Garden Theatre, and attracted for some time considerable notice.*

Anyhow, the universality of the prejudice against women whistling is an acknowledged fact, and there are few localities where one may not hear the familiar rhyme :

> "A whistling wife and a crowing hen
> Will call the old gentleman out of his den."

Of course there are various versions, as, for instance, in Northamptonshire, where the peasantry say :

> "A whistling woman and a crowing hen
> Are neither fit for God nor men."

The Cornish saying is to the same effect : "A whistling woman and a crowing hen are the two unluckiest things under the sun." Similar also is the French proverb, "*Une poule qui chante le coq et une fille qui siffle portent malheur dans la maison.*" The same superstition prevails among the seafaring community ; and Mr. Henderson† relates how, a few years ago, when a party of friends were about to go on board a vessel at Scarborough, the captain caused no small astonishment by declining in the most emphatic way to allow one of them to enter it : "Not that young lady," he cried out ; "she whistles." By a curious coincidence, the vessel was lost on her next voyage ; so, had the young lady formed one of the party, the misfortune would certainly have been attributed to her. After all, it seems hard that, if the mere act of whistling can help to cheer a man, such a soothing influence should be denied to a woman. "If whistling," says a writer in the "Phrenological Journal," "will drive away the blues and be company for a lonesome person, surely women have much more need of its services than their brothers, for to them come many more such occasions than to men. There is a physical advantage in whistling which should excuse it against all the canons of propriety or 'good form.' It is often remarked that the average girl is so narrow-chested, and in that respect compares so unfavorably with her brother, which may be due in some measure to the habit of whistling which every boy acquires." An eminent medical authority says : "All the men whose business it is to try the wind-instruments made at the various factories before sending them off for sale are, without exception, free from pulmonary affections. I have known many who, when entering upon this calling, were very delicate, and who, nevertheless, though their duty obliged them to blow for hours together, enjoyed perfect health after a certain time." As the action of blowing wind-instruments is the same as that of whistling, the effects should be the same. Whistling has been popularly styled the "devil's music," the reason, in all probability, being

* See an article entitled "Mouth Music" in "Book of Days," i, 751.

† "Folk-lore of the Northern Counties," 1879, p. 43.

that, when persons are up to anything wrong and likely to be caught, they assume an air of indifference by whistling. As the daily music of boys, however, it may be attributed to want of thought; and so Cowper, in his description of the "Postman" ("Task," book iv), says:

> "He whistles as he goes, light-hearted wretch,
> Cold and yet cheerful; messenger of grief
> Perhaps to thousands, and of joy to some,
> To him indifferent whether grief or joy."

In Shield's opera of "The Farmer," the singer—"now a saucy footman"—thus reverts to his boyhood:

> "A flaxen-headed cowboy, I whistled o'er the lea,
> And then a little plowboy, as happy as could be."

Dryden, too, says in his "Cymon and Iphygenia":

> "He whistled as he went, for want of thought."

And the same idea was perhaps in Milton's mind—

> "While the plowman near at hand,
> Whistles o'er the furrowed land."

Gay, also, wrote in the same strain:

> "The plowman leaves the task of day,
> And trudging homeward, whistles on the way."

The act of "whistling in one's fist," which is much in use among the lower orders, especially when they are desirous of sending the sound some distance, consists in bringing the thumbs of both hands together, leaving the hands and closed fingers to form a hollow space; then, by blowing through the narrow aperture left between the thumbs, a very loud and shrill whistle is produced. In Lincolnshire, in my school-days, says a correspondent of "Notes and Queries" (fourth series, ii, 213), this form of whistling used to be called the "thieves' whistle"—a name, by-the-by, which is still employed in London. Indeed, few subjects have given rise to a greater variety of popular every-day sayings than whistling. Thus the expression, to "pay for one's whistle"—a favorite phrase with George Eliot—means to gratify one's fancy. Again, a thing worthy of notice is said in common parlance to be "worth the whistle"; the reference obviously being to the ordinary way of calling up a dog. Heywood, for instance, in one of his proverbs, says, "It is a poor dog that is not worth the whistling." Shakespeare, too, makes Goneril say to Albany, in "King Lear" (Act iv, scene 2):

> "I have been worth the whistle."

Then there is the phrase, "To pay too dearly for one's whistle," implying that, after a person has paid dearly for something he fancied, he finds it does not answer his expectations. The allusion, says Dr. Brewer, in his "Dictionary of Phrase and Fable," is to a story told by

Dr. Franklin of his nephew, who set his mind on a common whistle, which he bought of a boy for four times its value. Franklin says the "ambitious who dance attendant on court, the miser who gives this world and the next for gold, the libertine who ruins his health for pleasure, the girl who marries a brute for money, all in the long run pay too much for their whistle." Once more, the old hackneyed proverbs "To wet one's whistle" and "To whistle for more" allude to the whistle drinking-cups of days gone by. It appears that, in the sixteenth and seventeenth centuries, silversmiths devoted a large amount of invention to the production of drinking-tankards, which took the form of men, animals, birds, etc., of most grotesque design.* According to one popular device, the cup had to be held in the hand to be filled, and retained there till it was emptied, as then only it could be set on the table. The drinker having swallowed the contents, blew up the pipe at the side, which gave a shrill whistle, and announced to the drawer that more liquor was required. Hence, too, no doubt, originated the phrase "whistle-drunk." Fielding relates how Squire Western, when supping one night at a friend's house, "was indeed whistle-drunk," for before he had swallowed the third bottle he became so entirely overpowered that, though he was not carried off to bed till long after, the parson considered him as absent.

The idea of ghosts whistling is still far from extinct in England, and enters largely into the folk-lore of our peasantry; a superstition which has been associated with the "Seven Whistlers," supposed by some to be phantom-birds. Thus, among the colliers of Leicestershire, we are told how, when trade is brisk and money plentiful, disposing them for a drinking-frolic, they are said to hear the warning voice of the "Seven Whistlers"—birds sent purposely, as they affirm, by Providence to warn them of an impending danger, and on hearing the signal not a man will descend into the pit until the following day.† Wordsworth, it may be remembered, in one of his sonnets, couples the "Seven Whistlers" with the "Gabriel hounds," those weird, mysterious specter-dogs which with such fiendish yellings haunt the midnight air:

> "The poor old man is greater than he seems:
> He the seven birds hath seen that never part,
> Seen the seven whistlers in their nightly rounds,
> And counted them; and oftentimes will start,
> For overhead are sweeping Gabriel's hounds."

The superstitious fear attaching to these whistlers is noticed by Spenser in his "Faerie Queen" (book ii, canto xii, stanza 36), where, "among the nation of unfortunate and fatal birds" that flocked about Sir Guyon and the Palmer, it is thus alluded to:

> "The whistler shrill, that whoso hears doth die."

* Chambers's "Book of Days," ii, 455.

† "Nature," June 22, 1871, 140; "Notes and Queries," fourth series, viii, 68.

It has been suggested that the whistler is the green plover to which Sir Walter Scott refers in "The Lady of the Lake," where he relates how—

"In the plover's shrilly strains
The signal whistle's heard again"—

its ominous shrill whistle which startles, with dreadful awe, the midnight traveler as he journeys along some lonely road, sounding far more like a human note than that of a bird. In illustration of this view we may quote the following anecdote related by a correspondent of "Notes and Queries" (fourth series, viii, 268), which, however, supports the popular theory of the birds in question being supernatural beings: "One evening a few years ago, when crossing one of our Lancashire moors in company with an intelligent old man, he was suddenly startled by the whistling overhead of a covey of plovers. My companion remarked that when a boy the old people considered such a circumstance a bad omen, 'as a person who heard the wandering Jews,' as he called the plovers, 'was sure to be overtaken by some ill-luck.' On questioning my friend about the name given to the birds, he said, 'There is a tradition that they contain the souls of those Jews who assisted at the crucifixion, and in consequence were doomed to float in the air forever.' When he arrived at the foot of the moor, a coach by which I had hoped to reach my destination had already started, thereby causing me to continue my journey on foot. The old man reminded me of the omen." To quote a further anecdote recorded by another correspondent of the same journal, we are told how during a thunder-storm which passed over the neighborhood of Kettering on the evening of September 6, 1871—on which occasion the lightning was very vivid—an unusual spectacle was witnessed: immense flocks of birds were flying about, uttering doleful, affrighted cries as they passed over the locality, and for hours they kept up a continual whistling like that made by sea-birds. "The following day," adds the writer, "as my servant was driving me to a neighboring village, this phenomenon of the flight of birds became the subject of conversation, and, on asking him what birds he thought they were, he told me they were what were called the 'Seven Whistlers,' and that whenever they were heard it was considered a sign of some great calamity, and that the last time he heard them was before the great Hartley Colliery explosion; he had also been told by soldiers that if they heard them they always expected a great slaughter would take place soon. Curiously enough, on taking up the newspaper on the following morning, I saw headed in large letters, 'Terrible Colliery Explosion at Wigan,' etc. This, I thought, would confirm my man's belief in the "Seven Whistlers." Among the pieces of folk-lore connected with whistling may be mentioned that of sailors whistling for a wind on a calm day; an expedient which they believe seldom fails. Thus Longfellow, in his "Golden Legend," speaks of this notion:

"Only a little hour ago,
I was whistling to St. Antonio
For a capful of wind to fill our sail,
And, instead of a breeze, he has sent a gale."

Sir Walter Scott, too ("Rokeby," ii, 11), says:

"What gales are sold on Lapland's shore!
How whistle rash bids tempests roar!"

Among the numerous anecdotes connected with whistling, it may be remembered that in the train of Anne of Denmark, when she went to Scotland with James VI, was a gigantic Dane of matchless drinking capacity. He possessed an ebony whistle which, at the beginning of a drinking-bout, he would lay on the table, and whoever was last able to blow it was by general consent considered to be the "champion of the whistle." It happened, however, that during his stay in Scotland the Dane was defeated by Sir Robert Laurie, of Maxwelton, who, after three days and three nights of hard drinking, left the Dane under the table, and "blew on the whistle his requiem shrill." The whistle remained in the family seven years, when it was won by Sir Walter Laurie, son of Sir Robert. The last person who carried it off was Alexander Ferguson, of Craig-darroch, son of "Annie Laurie," so well known. Burns has immortalized the subject in a poem entitled "The Whistle," from which we quote the following stanzas:

"I sing of a whistle, a whistle of a worth,
I sing of a whistle, the pride of the North,
Was brought to the court of our good Scottish king,
And long with this whistle all Scotland shall ring.
Old Loda, still rueing the arm of Fingal,
The god of the bottle sends down from his hall;
'This whistle's your challenge—to Scotland get o'er,
And drink them to hell, sir, or ne'er see me more!'" etc.

The Russians in the Ukraine tell a queer story about a whistling robber of olden times, who evidently was a person of gigantic proportions, for he was in the habit of sitting on nine oak-trees at once. One of the nicknames given to him was "Nightingale," on account of his extraordinary whistling powers. Should an unwary traveler come across his path, he would whistle so melodiously that his victim would quickly faint away, whereupon he stepped forward and killed him outright. At last, however, a well-known hero, by name Ilja Marometz, determined to subdue the robber, and, having shot him with an arrow, took him prisoner, carrying him off to the court of the Grand Prince Vladimir. Even there he proved dangerous, for when the grand prince, merely from curiosity, commanded him to whistle, the grand princess and all the royal children being present, the man commenced whistling in such an overpowering manner that soon Vladimir with his whole family would inevitably have been dead had not

one of his brave courtiers, perceiving the danger, got up and shut the whistler's mouth.*

We must not omit to mention the celebrated "Whistling Oyster," which about forty years ago created such a sensation at the small oyster and refreshment rooms situated in Vinegar Yard, near Catherine Street, Strand. "It appears," says a writer in the "Daily Telegraph," "that about the year 1840, the proprietor of the house in question, which had then, as it has now, a great name for the superior excellence of its delicate little 'natives,' heard a strange and unusual sound proceeding from one of the tubs in which the shell-fish lay, piled in layers one over the other, placidly fattening upon oatmeal, and awaiting the inevitable advent of the remorseless knife. Mr. Pearkes, the landlord, listened, hardly at first believing his ears. There was, however, no doubt about the matter. One of the oysters was distinctly whistling, or, at any rate, producing a sort of 'sifflement' with its shell. It was not difficult to detect this phenomenal bivalve, and in a very few minutes he was triumphantly picked out from among his fellows, and put by himself in a spacious tub with a bountiful supply of brine and meal. The news spread throughout the town, and for some days the fortunate Mr. Pearkes found his house besieged by curious crowds. That this Arion of oysters did really whistle is beyond all question. How he managed to do so is not upon record." As may be imagined, the jokes to which this fresh wonder of creation gave rise were unlimited; and Thackeray was in the habit of relating an amusing story of his own experience in connection with it. It appears that he was one day in the shop when an American came in to see this startling freak of nature; after hearing the talented mollusk go through its usual performance, he walked contemptuously out, remarking at the same time that "it was nothing to an oyster he knew of in Massachusetts, which whistled 'Yankee Doodle' right through, and followed its master about the house like a dog." Douglas Jerrold surmised that the oyster had undoubtedly "been crossed in love, and now whistled to keep up appearances, with an idea of showing that it didn't care." The subsequent fate of this interesting creature, says Mr. Walford,† "is a mystery—whether he was eaten alive, or ignominously scalloped, or still more ignominiously handed over to the tender mercies of a cook in the neighborhood, to be served up in a bowl of oyster-sauce as a relish to a hot beefsteak. In fact, like the 'Lucy' of Wordsworth—

'. . . none can tell
When the oyster ceased to be.'

But it is somewhat singular that so eccentric a creature should have existed in the middle of London, and in the middle of the nineteenth century, and that no history of his career should be on record." Last-

* Carl Engel, "Musical Myths and Facts," i, 92, 93.
† "Old and New London," iii, 284.

ly, although whistling would seem to be as natural an act as that of laughing, yet we are told by Mr. Shortland that it was formerly unknown among the New-Zealanders.* When, too, on one occasion a native of Burmah observed an American missionary whistling, he exclaimed in astonishment, "Why! he makes music with his mouth!" a remark which the missionary noted down in his journal with this note: "It is remarkable that the Burmese are entirely ignorant of whistling."†—*Gentleman's Magazine.*

SKETCH OF PROFESSOR BENJAMIN SILLIMAN, LL. D.

THE name of Professor Benjamin Silliman is intimately connected with the progress of science in the United States during the former half of this century, and is identified with the beginning of the study of American geology.

BENJAMIN SILLIMAN was born in North Stratford (now Trumbull), Connecticut, on the 8th of August, 1779. His oldest American ancestor on the father's side was believed to have been an emigrant from Holland, but there are reasons for presuming that he belonged to an Italian Protestant family that took refuge in Switzerland, and one of whose members afterward came to America, possibly sojourning for a short time in Holland. His grandfather was a graduate from Yale College, a Judge of the Superior Court of the colony, a member of the Governor's Council, and influential in public affairs. His father served with credit during the Revolutionary War as a brigadier-general, and enjoyed the confidence of Washington. On his mother's side he was descended from John Alden and Priscilla Muggins, of the Mayflower. After attending for a time the public school of his neighborhood, he prepared for college under the tuition of his pastor, the Rev. Andrew Eliot, and entered Yale College in 1792, the youngest but one in his class. He spent the year after his graduation at home, caring for his mother's farm; the next year he took charge of a select school in Wethersfield, Connecticut, and entered the law-office of the Hon. Simeon Baldwin, in New Haven, whence, after completing his three years' course in law, he was admitted to the bar in 1802. While still a law-student—in September, 1799—and when he had just reached the age of twenty, he was appointed a tutor in Yale College.

Up to this time classical instruction had received the predominant share of attention at Yale College, "theological, ethical, and metaphysical subjects were much cultivated, and logic was also a prominent topic"; mathematics was appreciated; much interest had been aroused

* "Traditions of the New-Zealanders," p. 134.

† Howard Malcolm, "Travels in Southeastern Asia," 1839, i, 205.

in astronomy; physics was less cared for, and chemistry had been "scarcely mentioned." Mr. Silliman was considering a proposition to settle down at the practice of the law in Georgia, when in July, 1801, President Dwight informed him that the corporation of the college had several years before resolved to establish a professorship of chemistry and natural history as soon as the funds would admit of it. The time had come when the resolution could be carried into effect, but it was impossible to find in this country a man properly qualified to discharge the duties of the office, while there were reasons that made the appointment of a foreigner inexpedient. The president saw no way but to select a suitable young man at home, and give him time to qualify himself for the professorship; and he had fixed upon Mr. Silliman as the person whom he would propose to the corporation. Mr. Silliman was inclined from the first to consider the offer favorably, because, as he has recorded in his "Reminiscences," "the study of Nature appeared very attractive. In her works there is no falsehood, although there are mysteries to unveil, which is a very interesting achievement. Everything in Nature is straightforward and consistent. There are no polluting influences; all the associations with these pursuits are elevated and virtuous, and point toward the infinite Creator." The professorship was instituted in 1802, with a provision that such time as might be agreed upon should be given the professor-elect to decide whether he would accept the appointment, and Mr. Silliman was chosen professor. Philadelphia then "presented more advantages in science than any other place in the country," and he went there first. Here he enjoyed the instruction, with experiments, of Dr. James Woodhouse, of the Medical College, and had as a fellow-boarder Robert Hare, who had just perfected his oxyhydrogen blow-pipe, and was much occupied with the subject, and enlisted his new friend in his service. He also attended the lectures of Dr. Barton on botany and of Dr. Caspar Wistar on anatomy and surgery, and met Dr. Priestley at the house of the latter. He received valuable suggestions from Dr. Maclean, of Princeton, whom he visited in his transits to and from Philadelphia; and thus he learned to regard the eminent professor as his earliest master in chemistry, and Princeton as his first starting-point in that pursuit, although he had not an opportunity to attend any lectures there. Having attended two winters in Philadelphia, he returned to New Haven and began to write his lectures. His first lecture was delivered April 4, 1804, when he was twenty-four and a half years old, to a class which included, among other men who afterward became distinguished, John C. Calhoun, Bishop Gadsden, and John Pierpont; the subject was the history and progress, nature and objects, of chemistry. Four lectures were given in a week—sixty in the course—and some notices of mineralogy were included.

In the mean time, the corporation of the college had voted to spend ten thousand dollars in Europe during the ensuing year, in the purchase

of books and philosophical and chemical apparatus. Professor Silliman applied for the privilege of going as purchasing agent, suggesting that his salary, which would be continued, and the agent's commission would pay his expenses, and he would, at the same time, have an opportunity of improving in his profession. His proposition was accepted; armed with a multitude of letters of introduction, the general effect of which he found to be equivalent to an order—"Sir: Please to give the bearer a dinner, and charge the same to yours," etc.—he spent a year in Europe. He performed experiments with Frederick Accum, the German chemist, and attended the lectures of Dr. George Pearson on chemistry, materia medica, and therapeutics, in London; heard Drs. Hope, Gregory, and Murray, in chemistry and geology; subscribed to Dr. Munroe's and attended Dr. Barclay's courses in anatomy, at Edinburgh; visited the Continent, and made the acquaintance of the most eminent scientific men of the day. Geological science at that time, he says, in his "Reminiscences," "did not exist among us, except in the minds of a very few individuals, and instruction was not attainable in any public institutions." In Edinburgh there were learned and eloquent geologists and lecturers, and ardent and successful explorers, and the contest between the Wernerians and the Huttonians was at its height. Professor Silliman was interested in the discussions, and, giving his attention to the subject, reached a standard of attainment in geology which he believed he could not have gained at home. He read the arguments on both sides, and came to the conclusion on which geologists are generally now tacitly agreed, that "both theories were founded in truth, and that the crust of the earth had been formed and greatly modified by the combined, or sometimes antagonistic and conflicting, powers of fire and water."

Professor Silliman had already attended to the care of the modest collections of minerals belonging to the college. There were a few metallic ores which had been named by Dr. Adam Seybert, of Philadelphia; a small collection which Dr. Semper had brought from England, containing some beautiful specimens, particularly in the lime family; and his own collections made in the mines of Derbyshire and Cornwall, in England, and local specimens obtained in his rambles among the trap-rocks of the Scottish capital, with a purchased suite of Italian polished marbles, all of which "when arranged, labeled, and described in illustration of the mineral portion of the chemical lectures, served to awaken an interest in the subject of mineralogy, and to produce both aspirations and hopes looking toward a collection which should by-and-by deserve the name of a cabinet." One of the first things to be done after returning home was to study the geology of the vicinity of New Haven, in the light of the knowledge that had been gained in Edinburgh. The result of this survey was a report, printed in the first volume of the "Transactions" of the Connecticut Academy of Arts and Sciences, in which an attentive reperusal

by the author fifty-two years afterward suggested very few alterations and disclosed no important errors. The cabinet of Mr. Benjamin D. Perkins was shortly afterward purchased for a thousand dollars, and in 1810 the splendid cabinet of Colonel George Gibbs was deposited in the college. The latter cabinet, which attracted visitors from all parts of the country, was bought fifteen years afterward. While Professor Silliman was engaged in arranging it, the Rev. Dr. Ely accosted him: "Why, dominie, is there not danger that with these physical attractions you will overtop the Latin and the Greek?" Professor Silliman replied: "Sir, let the literary gentlemen push and sustain their departments. It is my duty to give full effect to the sciences committed to my care."

An "American Journal of Mineralogy" had been started by Dr. Archibald Bruce, of New York, in 1810, but had been suspended after the publication of four numbers. Professor Silliman, at the suggestion of Colonel Gibbs, and with the approbation of Dr. Bruce, started, in 1818, a journal intended to include the entire circle of the physical sciences and their applications. This was "Silliman's" (now the "American") "Journal of Science," which is still continued under the direction of the son and son-in-law of its founder.

The courses of popular lectures on scientific subjects which were conducted by Professor Silliman in the different cities of the United States, originated in 1808, when a course in chemistry for ladies and gentlemen was proposed to him, and gladly assented to, as a scheme in the interest of scientific progress. A class of about forty-five persons was formed, and listened to the instruction given them apparently with complete satisfaction, for it appeared afterward, the lecturer remarks, in speaking of the matter, that the course "turned on female hinges," and "sentiment lubricated the joints. . . . It was my province to explain the affinities of matter, and I had not advanced far in my pleasing duties before I discovered that moral affinities, also moving without my intervention, were playing an important part." One of the affinities involved the professor, and his marriage to Miss Harriet Trumbull, daughter of the second Governor Trumbull, and one of his hearers, followed in the course of the next year. Many years afterward he was invited to deliver a course in Hartford—the first out of New Haven; then followed courses in Lowell, Boston (where "the Orthodox and Unitarian influence was united in his favor," and where he returned to lecture in several successive years afterward), other New England towns, and New York. In 1843 he lectured in Pittsburg, where he received most "vivid demonstrations of kind and gratified feelings"; the next year in Baltimore, where he found that "people who came for once, staid"; and afterward in Baltimore again, Mobile, New Orleans, Natchez, at Washington before the Smithsonian Institution, and in St. Louis. The calls to lecture continued actively through twenty-three years, from 1834 to 1857. In

summing up the results of these courses, Professor Silliman expressed a feeling of satisfactory assurance that he had popularized science; that at no period of his life had his efforts been more useful, both to his country and his family; and that there was no part of his professional career which he reflected upon with more satisfaction.

He was accustomed to explain the success of his lectures, and the uninterrupted interest they attracted, by stating that he always prepared them "with all possible care, and arranged every experiment and illustration so as to insure success. Then I could stand before the largest audience without anxiety or embarrassment; could, without manuscript, clearly state and explain my subject, and, when the proof became necessary, I could perform the experiments successfully and even beautifully, and exhibit the specimens which some other truth demanded, to insure conviction."

In 1830 Professor Silliman made a visit of exploration to the valley of Wyoming and its coal formations, where he examined some hundred mines and localities of coal, extending through forty miles in length; in 1832–'33 he was engaged, under a commission from the General Government, in a scientific examination on the subject of the culture and manufacture of sugar; and in 1836 he made a tour of investigation among the gold-mines of Virginia.

In 1840 an association of geologists was formed in Philadelphia for the purpose of promoting the progress of their science and its applications in this country, and Professor Silliman was chosen its first president. This society was in time succeeded by the "American Association of Geologists and Naturalists," and the latter eventually became the "American Association for the Advancement of Science."

In 1849 Professor Silliman, having reached the age of seventy years, tendered a resignation of his professorship, to take effect at the end of the ensuing academic year. The corporation, only half accepting his resignation, requested him to continue his lectures in the department of mineralogy and geology, should his life and health be spared. Later, at the request of the corporation, he reconsidered his resignation, and continued in the full occupation of his professorship till 1853, when, "wishing to go out before he should be compelled by infirmity, and to march out of the camp with colors flying," he retired finally. "Thus," he remarks in his journal, after referring to the public notices that were taken of his retirement during commencement-week, "I have finished my regular connection with Yale College, after having been almost fifty-four years an officer of the institution—three years a tutor, fifty-one a professor, and almost fifty a lecturer. . . . I seem to have attended my own academic funeral, and many to be the mourners on the occasion." The corporation requested him to continue as a professor emeritus, with the right to vote in the academical and medical faculties. His professorship was divided, and he had the satisfaction of seeing his son placed in the chair of Chemistry, and

his son-in-law, Professor Dana, in that of Geology and Mineralogy. The name of Silliman was given to both chairs.

Professor Silliman was still to continue a prominent figure before the public, kept so by other events than those connected with science and the affairs of the college. A few months after his resignation the Kansas-Nebraska controversy rose to its height, and the Republican party was born amid the convulsions it excited. Professor Silliman had always abhorred slavery, and he saw in these disputes great moral issues, and the question of the equal rights of citizens of all the States to settle in the Territories and defend themselves there. His active interest in these matters, and the works by which he showed it, called out bitter partisan reprobation, and this in turn invoked eloquent and deserved eulogies of his pure character and his attainments in science from Senators Foster and Dixon in the United States Senate.

Professor Silliman kept even pace with the progress of science and scientific ideas as they were developed through all his career, and let his religious faith shine at the same time with a light of even brilliancy. The possibility that there was a conflict or could be a conflict does not seem even to have occurred to him. From his earliest college-days, piety and a firm devotion in religious faith seem to have formed a prominent side of his character; yet he never hesitated to accept the most startling discovery, when it proved deserving acceptance. "Now, at eighty-two and a half years of age," he says, March 1, 1862, "I can truly declare that, in the study and exhibition of science to my pupils and my fellow-men, I have never forgotten to give all the honor and glory to the infinite Creator, happy if I might be the honored interpreter of a portion of his works, and of the beautiful structure and beneficent laws discovered therein by the labors of many illustrious predecessors. For this I claim no merit. It is the result to which right reason and sound philosophy, as well as religion, would naturally lead. While I have never concealed my convictions on these subjects, nor hesitated to declare them on all proper occasions, I have also declared my belief that while natural religion stands as the basis of revelation, consisting as it does of the facts and laws which form the domain of science, science has never revealed a system of mercy commensurate with the moral wants of man. In Nature, in God's creation, we discover only laws—laws of undeviating strictness, and sure penalties annexed for their violation. There is associated with natural laws no system of mercy; that dispensation is not revealed in Nature, and is contained in the Scriptures alone. With the double view just presented, I feel that Science and Religion may walk hand in hand." "For his own part," says Professor Fisher, from whose rich biography we have drawn freely in the composition of this sketch, "he felt that the Bible was a revelation from God. . . . Not being in the habit of resorting to the Scriptures for information in physical science, he had valued its early pages for the pure and sublime theism which they

inculcated. . . . Nor did he deem it necessary to suppose that the author of Genesis, however instructed by a higher light, was himself cognizant of the truths of geology, especially the truth of the great antiquity of the globe, and the length of time consumed in the geological changes." The idea of the length of geological time, as presented in his lectures, was novel to the majority of his auditors, and evidently shocked the prejudices of many of them, but he maintained it with vigor, and generally left a good impression regarding it in the end. Concerning the opponents of these ideas among the clergy, he wrote to Dr. Hitchcock in 1837: "I believe, with you, if they were masters of our subject, they would think as we do. Some of them are candid and forbearing; others find no insuperable difficulties; others are silent because they feel that they do not understand the matter; but a few are loud, confident, and uncharitable, while it is obvious they know not whereof they affirm, . . . but I see a strong purpose on the part of some to hold no terms with geology, and to insist upon the literal and limited understanding of the history; but they will find themselves deserted, for the matter will in time come right." Of a particular attack on the geological theory he wrote to Professor Hitchcock: "You and I *know* that any attempt to impair geological evidence, or to reconcile it with the popular view of time, must be abortive. No matter how violent or bitter our assailant may be, doubtless he will be more so in proportion to his ignorance of geology and to the strength of his prejudices."

Mrs. Silliman died in January, 1850, and Professor Silliman was married a second time, in the following year, to Mrs. Sarah I. Webb, of Woodstock, Connecticut. His death was apparently induced by a neuralgic attack which he incurred from attending a meeting on behalf of the Sanitary Commission, on the 13th of November, 1864. He was confined to the house for several days, but seemed afterward to recover, and made several calls in the neighborhood; but on the 24th—Thanksgiving-day—he died, instantly and without a struggle, just as he had remarked that he might perhaps go out to church. The disease from which he died was supposed to be an affection of the heart.

Professor Silliman, says his biographer, Professor Fisher, would have been the last to claim that he had that rare insight of genius which divines the secrets of Nature. His whole turn was more practical than speculative. "His perceptions were quick, his judgment sound, and all his mental operations were marked by good sense." His qualities "well fitted him for his peculiar work, and that was to collect and diffuse scientific truth. . . . Nor is he without merit as an investigator, although his distinction does not lie here. He was never very careful to claim for himself the credit of scientific discovery. At the same time, he took delight in bringing honor to the discoveries of others." He prepared an edition of Henry's "Chemistry," which

appeared in 1808, with the modest announcement, "To which are added notes by a professor in this country." While this work was going through the press, a remarkable meteor passed over New England (December, 1807), and exploded over Weston, Connecticut, where several stones fell to the ground. He visited the scene, and, besides publishing a popular account of the facts in the "Connecticut Herald," made them the subject of a scientific examination and report before the Philosophical Society of Philadelphia, which was afterward republished in the "Memoirs" of the Connecticut Academy of Arts and Sciences, and read aloud in the Philosophical Society of London, and in the Academy of Sciences in Paris. His two visits to Europe (the second one was in 1851) were followed by books of travels, both of which were received with great satisfaction, while the earlier one (1810) was highly commended, abroad as well as at home, as one of the best works of its class. He was the first to obtain potassium in this country, and the first to notice and record the effect of a powerful battery in volatilizing carbon and transferring it from the positive to the negative pole in a state of vapor. An account of his experiments with the oxyhydrogen blow-pipe was published in the "Memoirs" of the Connecticut Academy of Arts and Sciences in 1813. He published an account of a journey between Hartford and Quebec in 1820, an edition of Bakewell's "Geology" in 1829, and a text-book on chemistry, in two volumes, in 1830. It was largely through his influence that the Scientific School, started by the younger Professor Silliman in 1842, which was afterward endowed by the gentleman whose name it bears as the Sheffield Scientific School, was adopted by the college as one of its departments, in 1846 and 1847. Professor Silliman was for many years in regular correspondence with the most eminent scientific men of Europe, among whom may be named Berzelius, Robert Bakewell, Humboldt, Carl Ritter, Lyell, Sir R. I. Murchison, Richard Owen, Daubeny, Herschel, and Dr. Mantell. Some of these he never knew personally, but was brought into communication with them through a common interest in science.

CORRESPONDENCE.

WRITTEN AND UNWRITTEN CONSTITUTIONS.

Messrs. Editors:

A PERUSAL of your article in the March number of "The Popular Science Monthly," entitled "Law against Right," left an unpleasant impression on my mind, occasioned by the depreciatory criticisms upon lawyers with which it abounds. I am the more surprised at this, as, during many years' attentive reading of the "Science Monthly" I have had occasion to note the fairness and general freedom from invective which pervade your method of dealing with all questions discussed. It is not my purpose to express any opinion upon the merits or demerits of the law of copyright as it exists either in this country or in England, the subject which seems to have inspired your article. I only desire to say a word in behalf of lawyers as a professional class, and to express the opinion (and I say it after an active practice of nearly forty years in several different States, and some travel and observation abroad) that the lawyers in this country, under written constitutions, are no more given to "quibbles, devices, and sharp interpretations of law," than those of other countries.

While lawyers are responsible for the manner of presenting their clients' cases in court, judges for a proper interpretation of the laws, and jurors for such an application of the law to the facts of the case as will result in a rightful verdict, neither are directly responsible for the condition of the law itself, but must take it and apply it as they find it. Right here comes in the difficulty as to written as compared with unwritten constitutions of which you complain. It is no doubt true that in this country judges are bound by the fundamental written law, but they are not bound to sacrifice its main underlying purpose upon a given subject to the mere letter. The principle is as firmly rooted in our jurisprudence as in that of any country, that the mere technical letter of the text must give way to the clear purpose of the ordinance or law as gathered from a reasonable interpretation of the whole of the law bearing upon the particular subject; but where the meaning is clearly apparent it must prevail: if it is right, there is no ground for complaint; if wrong, the people here constitute the only tribunal to correct the error, and they alone should be held responsible for any resulting injustice, and not the lawyers or judges who are bound by their oaths to apply the law as they find it. The great body of the law is, of course, both here and in England, statutory; as to this the distinction as to written and unwritten law does not exist, and I hazard the opinion that as to this the administration of justice in England is not more elastic or less technical than here.

The main drift of your article tends to the point that unwritten constitutions provide a more ready means of attaining the ends of justice than written constitutions. The latter may afford some temporary advantages, but upon the whole I think the view you present is erroneous.

The science of law has had its conflicts with ignorance, prejudice, and false ethics, like most other departments of human thought, and I think it has made some progress, and quite as much progress in America as in Europe. The substitution of written for unwritten constitutions may be attended with some temporary evils and delays of justice, but upon the whole it can not be denied that they furnish more effectual barriers against the encroachments of arbitrary power upon the liberties of the people than mere traditional precedents which may be swept away under the spur of popular clamor, or set aside under the pressure of a ministerial or administrative crisis. The fundamental law should be in such condition that it will resist the pressure when the greatest strain comes upon it, for it is then that it is especially wanted. When the ship of state is sailing under clear skies and over smooth seas it matters little whether there is any constitution, written or unwritten; but when the stress does come, and either people or ruler *wants* to break down the barriers which the lessons of history and human experience have set up in the form of a constitution, it is then of supreme importance that the restraining power of the fundamental law should be an iron hand and not an elastic gutta-percha string, to be stretched at pleasure. Now, which is most likely to effect this purpose, the written letter, from the meaning of which there is no escape, or those traditional precedents which go under the name of unwritten constitutions, and which the ingenuity of man can readily torture into a construction favorable to the purpose of temporary usurpation?

The tendency of the times is to favor not only written constitutions but the codification of law, remedial and otherwise. The great body of the common law, as we all know, is not the work of Legislatures but the creation of judges, which has long obtained in this country, and upon the su-

perstructure of which judges have gone on building, creating a vast fabric of case-law, so voluminous and unwieldy that no mortal man, no matter how great his ability or attainments, can within the limits of human life fully master it. To remedy this, the evolution of the science of law has developed a method of collecting together, from the vast libraries of reported cases and judge-made laws, the settled principles therein contained, and of reducing them to a carefully arranged and harmonious system known as codes. This codification, when enacted by the Legislature, becomes the written law of the land, and takes the place of the uncertain elastic line of precedents founded on cases, and which, resting in the "bosom of judges," might be colored by their prejudices or warped by their interests or passions. If these views are correct, instead of unwritten law, either fundamental or statutory, furnishing the best means of promoting the ends of justice, the reverse is true, and the science of jurisprudence must advance along the paths of written laws, inflexible in their terms, and from which there is no escape other than through prescribed and appropriate methods of amendment.

CHARLES R. STREET.

HUNTINGTON, SUFFOLK COUNTY, N. Y., *March* 26, 1883.

RECLAMATION.

Messrs. Editors:

IN the April number of "The Popular Science Monthly," page 795, Mr. H. H. Bates cites Maxwell's article, in the "Philosophical Magazine" for 1877, page 453. More than five years before the publication of Maxwell's note, I had shown ("Proc. Am. Phil. Soc.," xii, 394) that the ratio of the vivial of wave-propagation to the vivial of its oscillating particles is 5 : 9, and that the ratio is determined by the secondary center of oscillation between the ethereal center of gravity and the ethereal center of linear oscillation. Maxwell gave no reason for his deduction, and his executors have been unable to find any among his papers.

PLINY EARLE CHASE.

HAVERFORD COLLEGE, PA., *April* 7, 1883.

EDITOR'S TABLE.

SCIENCE, LITERATURE, AND THEOLOGY.

THE discussion of the relations of these great elements of thought proceeds vigorously. "Line upon line and precept upon precept" accumulate; while the last instructive line respecting science and literature comes from the London "Times," and the last weighty precept concerning science and theology from the President of Harvard University.

In connection with the meeting of the civil engineers, held recently in London, the "Times" of that city makes the following significant declarations, which it is desirable to place upon permanent record, both as the deliberate utterance of an influential organ of public opinion and because of the incontestable truth of the statement itself. The "Times" says:

"Meetings such as that of Saturday evening remind us not merely of the services of a particular branch of science to mankind, but of the remarkable determination of human activity to scientific pursuits which is characteristic of the present age. Literature no longer holds the place it once did in the minds of men; nor does it command, as it once did, the services of the most powerful intelligences. The protest against an education wholly or chiefly consisting of the study of the classics is the result of a profound change in the conditions of life. Men have not deliberately and as a result of abstract reasoning discarded one set of studies in favor of another. On the contrary, they have discovered, often to their great chagrin, that a complete intellectual displacement has taken place. That which was taken up under protest, as a thing too closely connected with utilitarian pursuits to be quite worthy of a man of intellect, has now pressed into its service the chief intellectual power of the country. The tide of intellectual effort sets strongly in the direction of science, just as at an earlier period it set in the direction of letters. The teachers and leaders of the day, the

real dominant forces of the age, are the men of science, the investigators of natural phenomena, not the thinkers, philosophers, or metaphysicians who formerly gave their name to sects, and made all the world their partisans. Nothing is more remarkable than the profound respect of the scientific conception associated with the name of Darwin, not on science only, but on literature, art, morals, and, in short, upon life. Some will tell us that all this is a lamentable result of the materialism of the age; but we naturally ask how it happens that some centuries of a non-scientific or literary culture left us a prey to the materialism it is supposed to antidote? It is untrue, moreover, that material interest has been the great impelling force. The great discoveries of science have usually been made by men seeking no material reward, and, as a matter of fact, receiving very little. Science pursues her own way for the most part, and her discoveries are afterward utilized by men eagerly seeking for the means of material enrichment. Even when it is a question of so practical a thing as a new dye, it will be found that the chemist, searching into the properties and combinations of matter, comes upon the secret unawares, while the manufacturer and the dyer reap the profits. It is, indeed, only upon these terms that Nature yields up her secrets."

Quite in the spirit of the foregoing, though in a different and more special direction, is the article of President Eliot, of Harvard, in the "Princeton Review" for May, "On the Education of Ministers." President Eliot declares that the education of the clerical profession has fallen so far behind the age as to be out of relation with it, and to have consequently lost its ancient commanding influence, and even resulted in the degeneration of the clerical character. In the early part of his able article he shows the eminent position formerly occupied by the clergy as intellectual leaders. They were founders of colleges, and the largest professional class among the students. While a hundred years ago in Harvard, Yale, and Princeton the clerical graduates were respectively 29, 32, and 45 per cent, they have now fallen so far behind that "in the six years from 1871 to 1876 the percentage of ministers among the graduates of the same institutions was, in Harvard, 5¾; in Yale, 7; in Princeton, 17." President Eliot then glances at the great changes that have gone forward in society during the last hundred years, profoundly affecting the beliefs of men on many important questions, and bringing new and extensive knowledge to bear upon practical and every-day problems in relation to social affairs. Coincident with these movements, the temper of the public mind has undergone a wonderful change within a century upon several points which vitally affect the clerical profession. In the first place, the weight of all authority has greatly diminished, and the sources of recognized authority are quite different from what they were a century ago. The priest, like the secular ruler, has lost all that magical or necromantic quality which formerly inspired the multitude with awe; and the divine right of the minister is as dead among Protestants in our country as the divine right of kings. . . . Again, the people in these days question all things and all men, and accept nothing without examination. They have observed that discussion often elicits truth, that controversy is useful on many difficult subjects, and that in some circumstances many heads are better than one; hence they have learned to distrust all *ex cathedra* teaching, and to wait for the consent of many minds before giving their adhesion to new doctrines. We hardly realize how very recently the masses have acquired these invaluable habits, or how profoundly these habits have affected the position of the minister."

But it is in the recent progress of science that President Eliot finds the influence by which the position of the clerical profession is most profoundly affected in these times. On this subject he says: "We come now, in the fourth place under this head, to the most potent cause of change in the relative position of the ministry within this century, namely, the rise and development of physical and natural science. The immense acquisitions of actual knowledge which have been amassed in this new field, the great increase of man's power over nature, the consequent changes in each man's relations to his fellow-men and to the physical earth, including the wonderful expansion of his interests and sympathies, his emancipation from superstitions, and the exaltation of his prospects and hopes, are all facts of the utmost moment to the race; but it is not these facts, tremendous though they are, which most concern us in the present discussion. The important point for us now to observe is that, during the growth of natural science, a new method or spirit of inquiry has been gradually developed, which is characterized by an absolute freedom on the part of the inquirer from the influence of prepossessions or desires as to results. This spirit seeks only the fact, without the slightest regard to consequences; any twisting or obscuring of the fact to accommodate it to a preconceived theory, hope, or wish, any tampering with the actual result of investigation, is the unpardonable sin. It is a spirit at once humble and dauntless, patient of details, drawing indeed no distinction between great and small, but only between true and false; passionless, but energetic, venturing into pathless wastes to bring back a fact, caring only for truth, candid as a still lake, expectant, unfettered, and tireless.

"The achievements of scientific inquirers, animated by this spirit of sincerity and truth, have been so extraordinary within the past sixty years, and this candid spirit is in itself so admirable, that the educated world has accepted it as the only true inspiration of research in all departments of learning. No other method of inquiry now commands respect. Even the ignorant have learned to despise the process of searching for proofs of a foregone conclusion. Apologetics have ceased to convince anybody, if they ever did. Thus the civilized world has set up a new standard of intellectual sincerity, and Protestant theologians and ministers must rise to that standard if they would continue to command the respect of mankind. How different was the situation of the profession when diplomacy was the only other learned calling! Even the legal profession, as it was gradually differentiated from the clerical, made no such sharp requisition of mental honesty and independence. It is the electric light of science which has made white and transparent the whole temple of learning. These remarks imply that ministers, as a class, and as a necessary consequence of the ordinary manner of their education and induction into office, are peculiarly liable to be deficient in intellectual candor; and that is what I, in common with millions of thoughtful men, really think; and I think further that this belief on the part of multitudes of educated men, most of whom are silent on the subject, is a potent cause of the decline of the ministry during the past forty years. The fault is quite as much that of the churches or sects as of the individual ministers; for almost every church or sect endeavors to tie its members, and particularly its ministers, to a creed, a set of articles or a body of formulas. These bonds are put on by most ministers at an early age, and must be worn all their lives, on peril of severing beloved associations, or, perhaps, losing a livelihood. The study, reading, and experience of fifty years are supposed to work no essential change in the opinions of the

youth. The creed or the articles may be somewhat vague and elastic, but can not honestly be stretched much. Now, the lay world believes in the progress of knowledge, because it has witnessed progress; and it is persuaded that there must be incessant progress in theological science as well as in all other branches of learning. It does not see metaphysicians, physicians, historians, chemists, zoölogists, or geologists, committing themselves in youth to a set of opinions which is to last them a lifetime, or even a day; on the contrary, they see all these classes of scholars avowedly holding their present opinions subject to change upon the discovery of new facts, or of better light upon old facts, and, as a rule, actually modifying their opinions in important respects between youth and age. Indeed, fixity of opinion is hardly respectable among scholars. If it be said that there can be no progress in theology, because revelation was a fixed historical quantity, the answer is, that revelation, like creation, must be fluent; or, in other words, that the interpretation of revelation to the mind of man must be like the interpretation of creation, ever flowing, shifting, and, if the mind of man improves, improving. No other profession is under such terrible stress of temptation to intellectual dishonesty as the clerical profession is, and at the same time the public standard of intellectual candor has been set higher than ever before. This is the state of things which deters many young men of ability and independence from entering the profession, and causes the acknowledged dearth of able ministers."

HEBER NEWTON AND THE HERESY-HUNTERS.

THESE observations of President Eliot find an apt illustration in the case of the Rev. Heber Newton, which is now attracting a good deal of public attention. Intelligence and liberality have undoubtedly made great headway, and put the theological profession out of joint with the enlightenment of the times; but there is a pious-ignorant class of great influence that is not to be overlooked. Is it indeed so certain whether intelligence or stupidity is in the saddle in the popular theological arena? Certain foolish fanatics have combined to hunt the Rev. Heber Newton out of the Episcopal Church, on the old charge of heresy. And what is the pretext of this action? Why, the reverend gentleman appears to have been doing a little thinking on his own account—the mortal sin of theology! They say he made a solemn bargain, a vow, that he would do no independent thinking, have no opinions of his own, but simply re-echo the authorized creed, and that, having now begun to inquire, he is no longer fit to remain in the Christian Church.

Mr. Newton has ventured to think and to speak about the use and abuse of the Christian Scriptures—a proper subject, one would suppose, for a clerical teacher. He has opinions, sincere opinions, which he deems important, about the inspiration of the Bible, and how that phrase is to be understood. Now, it is incontestable that there has grown up an interesting and important accumulation of knowledge about the Bible in recent years, and knowledge determines opinion, in spite of all the theology in the world. And so it comes about that Mr. Newton, having convictions upon the inspiration of the Bible, must suppress them, and thus go along in comfortable hypocrisy, or express them, and be turned out of the Church. This was the dark age policy, with certain grim accompaniments; but is the stupid bigotry of by-gone ages still in the Episcopal saddle? We shall see.

Meantime, we venture to suggest that the heresy-hunters widen a little the scope of their operations; for, if they are going to make thorough work in purging the Church from all ad-

vanced opinion, and turn out everybody who blinks at the literalness of the verbal creed, they will have plenty of business, and can find a good many more cases quite as bad as that of Mr. Newton. We are told that the case is simply one of breach of contract. Enterprising editors, to whom an ecclesiastical trial would be as much of a godsend as the Saratoga horse-races, are especially solicitous about Heber Newton's contract to preach certain things which he is bound and sworn to preach while he remains in the Church.

Now, suppose these heresy-hunters institute an inquiry as to the extent of clerical dereliction in maintaining acknowledged Christian foundations. There can not be the slightest doubt as to the fundamental importance of a belief in hell, in our system of orthodox theology. It is the basal, and topmost, and all-impelling idea. The conception of hell is the corner-stone of the orthodox edifice, the key-stone of the orthodox arch; and, what the fires under the boiler are to the steam-engine, that are the fires of hell to the orthodox "scheme of salvation." The idea pervades the Christian theology and hymnology, and has been preached, sung, and prayed now for some eighteen hundred years, the proclaimed object of the whole theological system being to save men from hell! Such being the theological import and historic prominence of the doctrine, which is explicitly conserved in the creeds, and solemnly avowed by all orthodox clergymen, would it not be well to look a little into the growth of modern heresy regarding it in the very bosom of the Church? How is it about the enforcement of the hell-fire contracts? It would be interesting to know how many times the fundamental hell-doctrine is referred to in the course of ordinary pulpit ministration, and how it is slurred over and put aside and ignored as if the preachers were ashamed to allude to it. We think an inquest of this sort would reveal the fact that there is a good deal more reservation, and private interpretation, and playing fast and loose with creed and Scripture, than our heresy-hunters are aware of; and, if they pushed their inquisitorial work very far in this direction, they would be pretty sure to vacate half the pulpits in the land.

THE BANQUET TO DR. HOLMES.

All who had the good fortune to be present at the complimentary dinner to Dr. Oliver Wendell Holmes, given by the Medical Faculty of New York at Delmonico's, April 12th, will long remember it as a rare occasion. It was a most appropriate tribute of honor to the distinguished guest, and the taste and elegance displayed in the banquet and the excellence of the judiciously chosen speakers did abundant credit to the managers of the affair. But their task was not difficult, for hardly ever before were such favorable elements combined to give success to such an occasion. In the first place, if the committee had gone around the world with lanterns, over all the lines of latitude and longitude, they could not have found another so eligible a man to exploit in the festive and honorary way as Dr. Holmes. Known, admired, and loved wherever the English language is spoken, illustrious as a poet, humorist, novelist, essayist, conversationalist, and lecturer, and, finally, so specially distinguished as an anatomist and physician as to command the high regard of the medical profession in the metropolis of the country, nothing was wanting to give inevitable success to any complimentary expression of unaffected admiration and profound respect. Delmonico is, of course, a constant quantity, and can be counted on for the perfection of a feast, but the intellectual furnishings in this case were spontaneous, varied, and also of the highest quality. When prose was exhausted, poetry came

to the rescue, eloquence flowed as freely as the wine, divinity refused to be outdone by medicine in praise of the guest, the press claimed him as a typical journalist always ready for sagacious comment upon memorable events, and literature and science pressed their rival claims for the inscription of the name of Holmes upon their banners. The doctor took it all with the most gracious good-nature, knowing as well as anybody that there was a great deal more truth than flattery in the cordial utterances of which he was the target, and he gave the supremest proof of imperturbable good-humor by submitting to the insatiate exactions of a crowd of autograph-hunters who cornered him for their diabolical purposes after twelve o'clock.

LITERARY NOTICES.

DYNAMIC SOCIOLOGY, OR APPLIED SOCIAL SCIENCE, AS BASED UPON STATICAL SOCIOLOGY AND THE LESS COMPLEX SCIENCES. By LESTER F. WARD, A. M. In two volumes. New York: D. Appleton & Co. Pp. 726 and 698. Price, $5.

IN the rush of publications from a teeming press there now and then comes a work of such grave and exceptional import as to demand a special and careful consideration, and among these are to be included the two comprehensive volumes now before us. Under the technical and somewhat unattractive title of "Dynamical Sociology," Mr. Ward has made an original and able contribution to the large and very important subject of social science. Although he is, of course, indebted to many sources for his materials, yet the handling of the topics is his own. His work is not a compilation or *résumé* of previous promulgations, but an elaboration of his own independent views; and he has constructed a system which, from its breadth, its scientific basis, and its elaborate method lays claim to the character of a philosophy.

It must be confessed that the presumptions in these times are strongly against the novel and ambitious reconstructions of thought, which so frequently challenge public attention, and, if the author were asked in this case for his credentials, he would probably say that they must be found in the book. Yet Mr. Ward is well known by his scientific, economical, and social contributions to the magazines, as well as by other publications of recognized merit, and if he has not before issued any considerable book, it is probably because he has been absorbed for the last ten years in the preparation of the extensive treatise now published.

Mr. Ward's title, as we have intimated, is unfortunate. Sociology is a forbidding word—snarled at by petty purists as illegitimate—and not yet settled and defined in familiar speech; while the kind of sociology designated as "dynamical" only deepens the obscurity, and makes it necessary, at the outset of any intelligible notice of the work, to explain what is meant to be indicated by these terms. This will, moreover, furnish the key to the method of the book.

The author assumes sociology to be a science already so well established as to take proper rank in the family of sciences. It deals with the laws of social phenomena, as botany deals with the vegetable kingdom, and zoölogy with the animal world. But science is of two kinds, pure and applied, the former consisting of an exposition of facts and principles, and the latter of their practical applications for purposes of utility. Pure sociology, therefore, confines itself to the classification of the facts and the elucidation of the principles of social phenomena. It deals with society by the natural history method, describing, analyzing, comparing, and generalizing the comprehensive data of the subject. Its aim is simply the establishment of a body of truth, without the formal consideration of its uses. This is sociology as generally and properly understood.

But Mr. Ward thinks that, when the practical applications of this science are to be considered, new terms are needed to mark an important distinction, and so he uses the word *statical* to characterize its common scientific form. But this established sociology, or "Statical Sociology," which consists of the classified facts and generalized principles of the science, he holds to

be of a negative or passive kind, and he says that this has hitherto proved sterile or unproductive of benefit to the community. Like the other sciences, it needs application to make it useful and valuable. But this application involves active human agency, the control of social effects, and, as man's effort and directive power is here the main idea, he expresses this element of force by the term *dynamic*, and calls this branch of the subject "Dynamic Sociology." On this view, statical sociology deals with the great processes of nature, with genesis and natural evolution; while dynamic sociology treats of psychic human agency, and artificial results in the social sphere.

Mr. Ward maintains that the time has come when sociology must pass formally from the theoretic to the applied stage. While admitting the impracticability of most of the measures that have aimed at social amelioration, he nevertheless considers that we can no longer avoid the endeavor to derive certain fundamental principles of social action that shall bring the phenomena of society under the same intelligent control that science has long made possible in the division of physical phenomena, and guide the active interference of man in the direction of social affairs and to the accomplishment of social ends. This he assumes to be the art stage in the development of the subject, in which purposed artificial agencies supplement and carry forward the natural processes of development for the attainment of the highest fruits of human progress.

Mr. Ward devotes his first volume mainly to "Statical Sociology." It opens with a long introductory chapter, presenting a general view of the entire scheme. This is followed by two historical chapters, reviewing the two great modern systems of Auguste Comte and Herbert Spencer, in a manner sufficiently full for his general purpose. Then follow four chapters dealing with the most fundamental principles of cosmical development, or evolution in the domain of purely natural phenomena. These are entitled respectively "Cosmogeny," "Biogeny," "Psychogeny," and "Anthropogeny," dealing with the genesis of worlds, of life, of mind, and of man, and naturally leading up to the higher department of "Sociogeny," or the genesis and development of human society. Following the current terminology, we have here to do with pure sociology only, or its treatment from the point of view of the laws of nature. As a comprehensive exposition of the doctrine of evolution, this volume has great merit.

Sociological study thus far, Mr. Ward maintains, has chiefly given attention to the genetic or unconscious progress of society. The causes that have produced this passive or unconscious social progress are subjected to a searching analysis, and are found in the *social forces*. These consist fundamentally in desires, but they are desires which inhere permanently in the nature of man as a living organism. They are divided into two great groups, the original, or essential, and the derivative, or non-essential, social forces. The essential forces are those desires which belong to man as an animal, and are necessary to the maintenance of the primary functions of nutrition and reproduction. The non-essential forces are those desires which have been developed in the course of evolution, and they are divided into the æsthetic, the emotional, or moral, and the intellectual social forces. The primary forces, which have led to social transformations, are, therefore, blind forces, which result to the performance of acts with no reference to their ultimate effects.

Mr. Ward's argument for dynamical sociology, to which his second volume is devoted, is not easily presented in a paragraph, but it is substantially as follows: The ultimate end of human action is well-being or *happiness*, but this can not be attained through direct effort; it requires means. There are five proximate ends standing in as many degrees of remoteness from the ultimate end, the attainment of any of which is equivalent to the attainment of all the less remote ones, and the ease in securing which is directly proportional to their remoteness. These proximate ends, therefore, constitute so many means to the attainment of the ultimate end of well-being.

The first of these proximate ends is human progress itself, which, in order to be true progress, must secure the ultimate end. But progress is not in any proper sense at-

tainable by direct effort; it must itself be sought through means. The means of progress, which therefore become the second proximate end, must consist in the proper kind of *action*, but such action is only less difficult of direct attainment than is progress itself. Here, again, the necessary means must be adopted to secure the end.

The higher forms of action, such as seriously affect the condition of society, are chiefly the result of the ideas or opinions entertained. In a general sense, then, *opinion* may be regarded as the means to action, and hence as the third proximate end. But direct attempts to influence opinion are also practically futile; means must be employed here, as before.

Ideas and opinions rest upon the data in possession of the mind. Such data, to conduce to the several proximate ends, and through these to the ultimate end of well-being, or happiness, must be in harmony with reality. In other words, the data of opinion must consist in *knowledge*. Knowledge, therefore, is the fourth proximate end, the attainment of which will carry with it that of all the less remote ones, and also that of the ultimate end. Now, knowledge may be attained by the direct effort of the individual; but the mind is most receptive of it during the plastic period of youth, before an appreciation of its value can have been acquired sufficient to insure the effort to obtain it. To leave it to enforce itself, therefore, is virtually to fail of its attainment, so that this also is to be secured only through means.

The means to knowledge is instruction or *education*. This is defined as "the universal distribution of the most important extant knowledge." As an end, education can be easily secured by direct effort, even of society in its collective capacity. It differs from all the other ends in requiring no further means for its accomplishment than the mere mechanical appliances. Education, therefore, constitutes the most remote proximate end, and the *initial means* to the attainment of all the less remote ends, and also of the ultimate end of the general welfare. All these ends may, therefore, be wholly neglected and left to take care of themselves, and the entire energy of society may be concentrated upon this most remote end, or initial means, to the highest social progress.

The second volume of Mr. Ward's work opens with a chapter treating chiefly of man's relation to the universe, which he insists must be more clearly conceived before any further progress can be made in philosophy, and it ends with a statement of the definitions and theorems of dynamic sociology. The remaining six chapters are devoted to the detailed consideration of the six theorems, one being given to each of the great ends, in the order in which we have noticed them. The work, therefore, closes with a radical discussion of the claims of education as above defined, as the supreme essential condition to further and higher social progress.

No idea can be given in such a brief notice as this of the number of important subjects of great public interest at the present time that are traversed by Mr. Ward in these solid volumes. The work is more constructive than critical, but it deals throughout with live topics and urgent public problems. The author takes radical issue with his philosophic predecessors, and arrives at new results for which he claims the sanction of science and reason. As the reader will perhaps have inferred, the drift of his reasoning is toward a great extension of coercive agency and government control in the work of social progress. His work is, in fact, a vigorous and systematic assault upon the doctrine of *laissez faire*, and the policy of leaving things to spontaneous influences and the self-regulation of private enterprise. It is, perhaps, the strongest defense yet made of the enlargement of state functions for the direction of social affairs. The task was an ambitious one, but the manner of its execution proves that it was not presumptuous.

The merits of Mr. Ward's work are unquestionably such as to entitle it to the serious attention of students; but, aside from its intrinsic claims, its logic is so strongly in the direction of predominant American tendencies, that it is sure to be welcomed by many as a representative exposition of American policy and thought. It appeals strongly to different classes of thinkers. Boldly coping with the ripened systems of the Old World, it will commend itself to many

who are ambitious about the development of philosophy on this side of the Atlantic. The work is, moreover, of an eminently practical sort, and deals with the relations of political and social science in their bearing upon the interests of the community in such a way as to entitle it to the consideration of statesmen and political economists. Besides, as it offers a new synthesis of facts, and aims to co-ordinate into a uniform scheme the accepted truths of all the sciences, it can not fail to awaken the interest of thinking scientific men in all departments. And, as the philosophy of religion is broadly and independently treated, the work is certain to have an interest for all schools of religio-philosophic speculation and inquiry. As Mr. Ward's work is thoroughly up to the times both in substance and spirit, the reader will of course be prepared for a good deal of freedom and boldness in discussion; but the author is no trifler, though, in the courageous expression of his convictions, he goes no further than is justified by the practice of this questioning age.

We may add that the work is written in a style that will commend it to popular readers. Mr. Ward makes himself perfectly understood, and without effort on the part of those who follow him. He is at times diffuse, and we think the work would have borne considerable condensation, but, believing that the views he desires to promulgate are important, the author seems to have been only solicitous for that fullness of statement that shall give completeness to his meaning in the reader's mind. The references to collateral discussion are numerous throughout the text, so as to facilitate the following out of any special argument, and the index to the work is careful and exhaustive. Mr. Ward has been arduously occupied upon his treatise for a long time, and may be congratulated upon the perfection of its form as a product of the book-making art.

It has been our purpose in this notice simply to give the best account we could in so brief a space of the general characteristics of the "Dynamic Sociology." Our readers hardly need to be reminded of our decisive dissent from the doctrines of the school of which Mr. Ward will now easily take the place of the ablest leader, but we have refrained from criticism, that our statement might be as far as possible fair and unbiased. There is, at any rate, a great deal in this work that is instructive, and to be cordially commended, and there are parts of it that we could wish to see more widely circulated than they can be in these formidable volumes. Though disagreeing with much that it contains, the book is nevertheless to be welcomed as a timely contribution to contemporaneous inquiry, and it will unquestionably aid in giving a fresh impulse and a fruitful direction to the discussion of large and momentous subjects.

INTERNATIONAL SCIENTIFIC SERIES. No. XLV.

MAN BEFORE METALS. By N. JOLY, Professor at the Science Faculty of Toulouse. With 148 Illustrations. New York: D. Appleton & Co. Pp. 365. Price, $1.75.

THE subject of the early history of mankind, in the light of the modern doctrine of the antiquity of man, is not only of growing interest, but in its researches and its expositions it is enlisting much of the leading talent of the age. It is established that we have to go back of all written history for that primitive basis of history which is written only in the book of nature. Here science comes to the aid of the philosophical historian, and reveals those conditions of man and society which are indispensable to the understanding of the subsequent course of humanity. Among the latest and ablest contributions to this subject is that by the eminent French authority, Professor Joly, whose contribution to the International Series is now rendered into English in a very popular form under the title of "Man before Metals." His book is an excellent compend of our present knowledge on the antiquity and early history of man, and the author's French clearness of statement has been well preserved in the translation.

In the first part of the volume, devoted to "The Antiquity of the Human Race," Professor Joly describes the discoveries that have been made in the bone-caves, the kitchen-middens of Denmark, the Sardinian Nuraghi, and on the sites of the Swiss lake-dwellings. A short chapter is devoted to "Prehistoric Man in America," but the

limits of the volume forbid any detailed account of discoveries outside of Western Europe. The author disparages certain attempts to estimate the number of years that man has lived on earth, and the duration of the stone, bronze, and iron ages, and maintains that all peoples have not passed through these three ages at the same time. Hence such divisions can have only a relative, not an absolute, chronological value. That human bones are found in strata where they could not have been buried in later time, and intermingled with bones of the cave-bear, the mammoth, the reindeer, and many other long-extinct species; that the bones of these beasts often bear wounds—sometimes partly healed—which were plainly made by the weapons found in the same localities; with other evidence still more remarkable—prove that man was present in Europe during the Quaternary age. Relics have been found that have convinced some archæologists of the presence of man during the Tertiary period, and this opinion our author shares, though he does not deem the assumption proved.

Part II, "Primitive Civilization," recounts what has been learned from the relics of primitive man as regards his domestic life, methods of industry, his progress in domesticating animals, in drawing and carving, his religious ideas, and customs of human sacrifice and cannibalism. The author concludes, from the data so far obtained, that primitive European man dwelt for a considerable period in caves. The flesh of the mammoth, the great cave-bear, the horse, the aurochs, and other animals, generally eaten raw, together with wild fruits and roots, formed his staple diet. The use of fire was known, and pottery had been invented. He clothed himself in skins, which he sewed by means of bone needles. Cannibalism was practiced to some extent, and the horrors of war were already known. But, in spite of his savage customs, "he was *man* in all senses of the word—anatomically, intellectually, and morally."

ON THE DESERT, WITH A BRIEF REVIEW OF RECENT EVENTS IN EGYPT. By HENRY M. FIELD, D. D. New York: Charles Scribner's Sons. Pp. 330. Price, $2.00.

We must confess to having read Dr. Field's book with great pleasure, and found it refreshing, entertaining, and instructive. We say "confess" in honest acknowledgment of an interest hardly expected in a new book on the wanderings of the old Jews. No doubt, we were prejudiced, as Hebrew matters had been somewhat overdone in our early education. Between the horrible droning sermons, mostly about the Israelites, which made the day of rest a weariness and a burden, and the Sunday-school exercises, which were worse because sleep was impossible, and the pious books about the patriarchs and prophets, which had to be read all during the week, we got an early surfeit of things Hebraic, and when there came at length the happy liberty of reading what we liked, the children of Israel got a wide berth, and we naturally failed to keep up with the progress of modern investigation into the profane aspects of Jewish history. But early associations are omnipotent, and we have accordingly gone through Dr. Field's book describing the present aspects of ancient sacred places with an unusual degree of satisfaction.

Dr. Field's volume, we observe, has been criticised for its want of novelty. It is said that he has gone over ground that has been traversed many times before, until its interest is exhausted, and that he has not been able to add anything new or important to what previous travelers had furnished. Very likely those who have kept up with Palestine explorations and antiquarian researches into the old haunts and relics of the Jewish people would find no important revelations in this volume. But it was not intended to enlighten those who have spent their lives in the study of Jewish history. The author offers his book merely as an introduction to the learned works of those who have devoted themselves to the investigation of the subject.

He says: "The Peninsula of Sinai has been a favorite ground of Biblical explorers. In their zeal to visit scenes made dear by connection with sacred history, they have sought to follow the track of the children of Israel from the time of their departure out of Egypt; to trace their marches on the desert; to fix the place of their encampments, not only around the base of Sinai, but even when wandering and almost lost in the great and terrible wilderness. The

fruit of these researches is a library of exploration, which forms a most valuable addition to our Biblical literature, not only for the knowledge it gives of sacred geography, but of the whole religious, social, and political economy of the Hebrews. While these great works, the monuments of so much learning, occupy the attention of scholars, other readers may be interested in turning over a portfolio of sketches, which claims only to present a few pictures of the desert."

From this point of view we have found the work extremely interesting. It is written in an easy and familiar style, and abounds in pleasant descriptions and common-sense reflections relating to the scenery of the country, the associations of prominent places, and the character and habits of the people that came under the author's observation. The first two chapters, devoted to Egypt and its relations to England, give an excellent summary of what is known as the "Egyptian question," and form an instructive preliminary to the subsequent chapters on the wanderings of a people so intimately associated as were the old Hebrews with the ancient Egyptians.

It was the object of our traveler to go over the ground traversed by the Hebrew people after their flight from Egypt. He accordingly crossed the desert by camel navigation, following their track, and lingering to observe the various locations that have derived their interest from the sacred history. Starting from Suez, the first point of interest reached was the wells of Moses at a mile or two on, and from this station the party pursued the route to Mount Sinai, a distance of one hundred and fifty-three miles, at the rate of twenty to twenty-five miles a day, the usual "camel's journey." After spending some time among the interesting scenes of Mount Sinai, they started through the mountains and struck into the great wilderness in which the children of Israel wandered for thirty-seven years before reaching the land of promise. The narrative then proceeds with its detail of incidents of tent-life, camping, and marching, and the description of desert scenes and memorable localities until the terrible wilderness is crossed, and the travelers emerge into the crude civilization of Palestine in the neighborhood of Gaza. From this point they proceeded through the hill country to Bethlehem, "the place where Christ was born"—a town, at present, of some five thousand inhabitants—and the chapter devoted to it is perhaps the most interesting in the book.

Of course, Dr. Field, as a good, sound, orthodox man, will not suffer his reader to suppose that he has taken this excursion from mere idle curiosity, but because of his profound religious interest in the history with which his observations are associated. The thread of narration is, therefore, once broken by an episode in which he goes into a discussion and a defense of the Hebrew polity which has been the subject of much criticism in these skeptical times. It is not so much his object to maintain the inspiration of Moses as to vindicate his wisdom and humanity as a lawgiver. His chapter on "Theocracy and Democracy," in relation to the Hebrew system of government, is readable and suggestive, but we suspect that the philosophy of the subject will not be cleared up until it is studied in the light of the great law of social evolution.

HOME GYMNASTICS; WITH A SHORT METHOD OF ACQUIRING THE ART OF SWIMMING. By T. J. HARTELIUS, M. D. Translated by C. Löfving. J. B. Lippincott & Co., Phila. Pp. 94. Price, 60 cents.

OF course, the importance of exercise to health is by no means a modern physiological discovery, but we undoubtedly owe to Ling, of Sweden, the most ingenious system of gymnastics, calculated to produce a harmonious development of the human organism, and to insure the preservation of health as well as the cure of diseases. It is said that Ling never used a movement of which he could not scientifically demonstrate the physiological effects, and there can be little doubt of the important influence it has exerted during the half-century that has elapsed since the promulgation of the "movement-cure."

The editor of this volume remarks that "it is dawning more and more upon the minds of physiologists and practitioners that 'motion is the principal agent in the whole process of life,' and that systematic muscular exercise is one of the best means for

influencing the vital actions of the body." And, such being unquestionably the case, our most practical concernment is with the best means of gaining the benefit of these systematic exercises. Those who have well-equipped gymnasiums within reach may be congratulated that the problem is solved for them, but the great mass of people are without such opportunities. The little work of Dr. Hartelius, which has been so judiciously translated, is exactly what is wanted for universal home use. Systematic exercises are described and illustrated, which are suited to strengthen and develop all parts of the muscular system, and this without the use of any other apparatus than a bench or seat, and even this is by no means indispensable. All that is required for exercise is the body itself, and as most people possess this outfit they need not be put to the slightest expense to secure a comprehensive system of gymnastic exercises, and which, moreover, shall be just as efficient as they choose to make it. Following the descriptions of movements are lists adapted for specific purposes, and for infants and old persons, as well as for those in full vigor.

THE ALTERNATIVE, A STUDY IN PSYCHOLOGY. New York: Macmillan & Co. Pp. 387. Price, $2.75.

THIS anonymous work is a vigorously written polemic on metaphysics in its more modern aspects. It is written with a conservative *animus*, and the author is of opinion that he has helped forward psychological inquiry in several important particulars. Mr. Henry Sidgwick, certainly a very competent authority, says, in an advertisement to the volume: "I have had an unexpected interim of enforced cessation from my work, which I have employed in reading about half the proof-sheets you sent me. Without reading any more—which for the present I have not time to do—I feel no doubt that the book deserves the attention of all students of philosophy from the amount of vigorous, precise, and independent thinking that it contains—thinking which appears to me generally consistent, so far as it has been completely developed, though, at some important points, the work of definition and analysis does not seem to me to have been carried far enough. I also find the terse, forcible individuality of the style attractive on the whole, though I can not but wish that the author had somewhat restrained his impulse to innovate in technical terminology."

IDYLS OF NORWAY, AND OTHER POEMS. By HJALMAR HJORTH BOYESEN. New York: Charles Scribner's Sons. Pp. 185. Price, $1.25.

THIS is a collection of brief poems, some forty in number, mostly on light and fanciful subjects suited to sentimental treatment. They are of excellent literary merit, and show a skillful mastery of English versification that is certainly remarkable in an author writing in a foreign tongue. The pieces in this volume are considerably varied, both in form and in the subject chosen; we have been most struck, however, with those on "The Sea," "The Air," and on "Evolution," the latter of which we have taken the liberty of transferring to our pages. The poetic treatment of the enlarged views of nature, for which we are indebted to science, is an important part of the "progress of thought."

ABORIGINAL AMERICAN LITERATURE.

THE second volume of Dr. D. G. Brinton's "Library of Aboriginal American Literature," is announced to appear in June. It is the "Iroquois Book of Rites," comprising the original text and a literal translation, with introduction, notes, and glossary, and is edited by Horatio Hale, Esq. This is a native composition, partly in the Mohawk and partly in the Onondaga language, and includes the proceedings observed in the council when a deceased chief is lamented and his successor is installed. The forms, after having been preserved and handed down in memory for several generations, were written down, by desire of the chiefs, when the language was first reduced to writing.

SCIENCE IN SHORT CHAPTERS. By W. MATTIEU WILLIAMS, F. C. S. New York: Funk & Wagnalls. Pp. 308.

THIS volume contains a great number of brief essays, popularly written, on a wide variety of scientific subjects, and the name of the author is a sufficient guarantee of the general soundness of the information and criticism presented in the book.

THE DIADEM OF SCHOOL-SONGS. By WILLIAM TILLINGHAST. Syracuse, New York: C. W. Bardeen. Pp. 160. Price, 50 cents.

THE "Diadem" is intended to facilitate instruction in sight-singing by ordinary teachers, even though they may not themselves be singers. Besides a new system of instruction arranged for this purpose, and a manual of directions for the use of teachers, it contains songs and music of varied character for all grades of schools.

PUBLICATIONS RECEIVED.

**** *Authors and others, sending papers and monographs for notice, will please specify, for general information, where they can be procured.*

Proposed Ordinance, and Rules and Regulations on Plumbing and House Drainage for Philadelphia. By the Committee of Twenty-one. Philadelphia: P. Blakiston, Son & Co. Pp. 14. 10 cents.

Report of the Director of the Illinois State Laboratory of Natural History. 1881–'82. By S. A. Forbes. Normal, Ill. Pp. 12.

The Sphingidæ of North America. By A. R. Grote, A. M. Washington, D. C. Pp. 5.

Books for the Young. Compiled by C. M. Hewins. New York: F. Leypoldt. Pp. 94. 25 cents.

University of Pennsylvania, Catalogue and Announcement, 1882–'83. Philadelphia. Pp. 116.

Entomological Papers from the "Transactions of the Iowa State Horticultural Society," 1882. Des Moines: F. M. Mills. Pp. 42.

"The American Fruit-Drier, or Pneumatic Evaporator." Waynesboro, Pa.: American Manufacturing Company. Pp. 48.

The Cornell University Register, 1882–'83. Ithaca, N. Y. Pp. 123.

The Physiology of Protoplasmic Motion. By Th. W. Engelmann, M. D. Translated by Charles S. Dolley, M. D. Rochester, N. Y.: Davis & Leyden. Pp. 40. 50 cents.

Proceedings of the Davenport (Iowa) Academy of Natural Sciences. Vol. III, Part III. Pp. 311, with Four Plates.

Lectures delivered to the Employés of the B. & O. R. R. Co. By Professor H. Newell Martin and Drs. H. Sewall, W. T. Sedgwick, and W. K. Brooks. Baltimore: B. & O. R. R. Co. Pp. 98.

The Q. P. Index Annual for 1882. Bangor, Me. Pp. 51.

The Bacteria. By T. J. Burrill, Ph. D. Springfield, Ill.: H. W. Rokker. Pp. 65. 50 cents.

Report of the United States Bureau of Statistics on Imports, Exports, Immigration, and Navigation, September 30 to December 31, 1882. Washington: Government Printing-Office. Pp. 359.

The Great Ice Age in Pennsylvania. By Professor H. Carvill Lewis. Pp. 21, with Map.

Scripture Opened. A Topical and Analytical Commentary. Acts. By Rev. J. M. Coon, Beaver Dam, Wis.

The Maintenance of Health. By J. Milner Fothergill, M. D., M. R. C. P. New York: G. P. Putnam's Sons. Pp. 366. Paper, 60 cents.

"Appalachia." April, 1883. Boston: W. B. Clarke & Carruth. Pp. 202. 50 cents.

Register of the Appalachian Mountain Club for 1883. Boston: W. B. Clarke & Carruth. Pp. 36.

The Higher Professional Life. By J. M. Da Costa, M. D. Philadelphia: J. B. Lippincott & Co. Pp. 18.

Reports of Experiments on Insects injuriously affecting the Orange-Tree and the Cotton-Plant. United States Entomological Bureau. Washington: Government Printing-Office. Pp. 62.

Reports of Observations on the Rocky Mountain Locust and the Chinch-Bug. United States Entomological Bureau. Washington: Government Printing-Office. Pp. 36.

United States Monthly Weather Review for February, 1883. Washington: Office of the Chief Signal-Officer. Pp. 52, with Maps.

Parish Institutions of Maryland. By Edward Ingle, A. B. Baltimore: Johns Hopkins University. Pp. 48. 40 cents.

Report of the Board of Commissioners of the Tenth Cincinnati Industrial Exposition. 1882. Cincinnati: James Barclay. Pp. 320.

Illustrated Art Notes of Fifty-eighth Spring Exhibition, National Academy of Design. By Charles M. Kurtz. New York: Cassell, Petter, Galpin & Co. Pp. 84. 25 cents.

A Roman Catholic Canard. Boston: "Investigator" Office. Pp. 16.

Two Great Works to be done on our Sidereal System. By Jacob Ennis. Washington, D. C.: Rudd & Detweiler. Pp. 12.

On the Action of Certain Vegetable Acids on Lead and Tin. By Francis P. Hall. Boston, Mass. Pp. 13.

Biennial Report of the Superintendent of Public Instruction of Florida. By E. K. Foster. Tallahassee, Fla.: Charles E. Dyke. Pp. 24.

Alcoholic Inebriety. By Joseph Parrish, M. D. Philadelphia: P. Blakiston. 1883. Pp. 185. $1.25.

Home Gymnastics. By Professor T. J. Hartelius, M. D. Philadelphia: J. B. Lippincott & Co. 1883. Pp. 94.

The Possibility of not Dying. By Hyland C. Kirk. New York: G. P. Putnam's Sons. Pp. 112. 75 cents.

French Forest Ordinance of 1669. With Historical Sketch of Previous Treatment of Forests in France. Compiled and translated by John C. Brown, LL.D. Edinburgh: Oliver & Boyd. Pp. 180.

The American Citizen's Manual. Part II. By Worthington C. Ford. New York: G. P. Putnam's Sons. Pp. 184. $1.

Marianella. By B. Perez Galdós. From the Spanish by Clara Bell. New York: William S. Gottsberger. Pp. 264.

Libraries and Schools. Papers selected by Samuel S. Green. New York: F. Leypoldt. Pp. 186. 50 cents.

Libraries and Readers. By William E. Foster. New York: F. Leypoldt. Pp. 136. 50 cents.

Brain-Rest. By J. Leonard Corning, M. D. New York: G. P. Putnam's Sons. Pp. 103. $1.

On Work and Wages. By Sir Thomas Brassey, K. C. B., M. P. New York: G. P. Putnam's Sons. Pp. 296. $1.

The Sciences among the Jews before and during the Middle Ages. By M. J. Schleiden, Ph. D. Baltimore: D. Binswanger & Co. Pp. 64.

Oliver Wendell Holmes, Poet, Littérateur, Scientist. By William Sloane Kennedy. Boston: S. E. Cassino & Co. Pp. 356.

Dr. B. C. Faust's Laws of Health. Translated and improved by Herman Kopp. Brooklyn: H. Kopp & Co. Pp. 37. 20 cents.

The Advanced Question-Book. By Albert P.

Southwick. Syracuse, N. Y.: C. W. Bardeen. Pp. 366. $1.50.

The Modern Sphinx, and some of her Riddles. By M. J. Savage. Boston: George H. Ellis. Pp. 160. $1.

Man before Metals. By N. Joly. New York: D. Appleton & Co. Pp. 365.

Manual of Assaying Gold, Silver, Copper, and Lead Ores. By Walter Lee Brown, B. Sc. Chicago: Jansen, McClurg & Co. Pp. 318. $1.75.

Authors and Publishers. A Manual of Suggestions for Beginners in Literature. New York: G. P. Putnam's Sons. Pp. 96. $1.

Eureka—The Mysteries of the World Mysteriously Revealed. By Asa T. Green. Cincinnati: A. G. Collins. Pp. 141.

History of Medical Economy during the Middle Ages. By George F. Fort. New York: J. W. Bonton. Pp. 488.

Life of Sir William E. Logan, Kt., First Director of the Geological Survey of Canada. By Bernard J. Harrington. Montreal: Dawson Brothers. Pp. 432.

POPULAR MISCELLANY.

How to act in a Tornado.—Sergeant John P. Finley, Signal-Service officer at Kansas City, Missouri, has published, in a pamphlet on tornadoes, some useful directions concerning the course to be taken to escape the dangers of those terrible forces. The inhabitant of a tornado-frequented district must be watchful in the season of visitations, for he can never know when the destruction will come upon him. On the first sign of the approaching vortex, he must run—always to the north, unless by going in that direction he will have to cross the entire path of the storm. If he is nearer to the southern edge than to the center of the probable path, he may go south, bearing slightly east; but in no event should he ever run directly to the east or northeast. It is impossible to save any building that may lie in the path of the tornado, or any property that can not be got out of its way. No material, no method of construction can be competent to resist the raging destruction. Nothing rising above the ground can escape it. The most practicable measure of precaution is to construct a "dug-out" at some suitable point, within easy distance from the house, to serve as a place of refuge or shelter. The retreat should be entirely under-ground, with a roof at least three feet thick, not rising above the surface of the earth, and entered from the northern or eastern side. A "cellar-cave" may be constructed from the cellar, if the house has one, to serve as a substitute for the "dug-out." It should be excavated from the west wall of the cellar, toward the west, and should be made as complete and secure as the "dug-out." If, however, the storm can not be escaped, if no refuge is at hand, or there is not time to get to it, the safest thing to do is to place one's self against the west wall of the cellar, face forward, or against the south wall, as near the southwest corner as possible. The northeast quarter is in any case a fatal position, and should always be avoided. If one is actually overtaken by the tornado, his only resource is to cast himself face downward upon the ground, with his head to the east and his arms thrown over his head to protect it. If a stump or large stone, or anything heavy that the wind will not blow over, is near, he may get a trifle of protection by throwing himself to the eastward of it. If in a house with no cellar, he should get into the west room, on the ground-floor if possible, and away from all stoves and heavy furniture. The people of towns might find it to their advantage to provide for having a watch, to be on duty on all days when the air bears the premonitory symptoms of a violent wind-storm, to give a signal to the whole population on the appearance of the first real threatening signs. The signs of the formation and approach of a tornado-cloud are distinct and sufficiently suggestive to afford opportunity for timely and concerted action. Sergeant Finley is continuing his investigations of the phenomena of tornadoes, and he has prepared three full schedules of minute inquiries calling for the facts attendant upon the appearance of the storms, which he sends to persons who were within the path of one, who were on the outer edge of the path, and who were from ten to one hundred miles from it.

Science and Faith.—"Science and Faith" was the subject of an address delivered some time ago by Professor A. J. DuBois, of the Sheffield Scientific School, before the Scientific Society of Bridgeport, Connecticut. The burden of the address is an attempt to show that the basis of all scientific knowledge is faith; that what we consider our most certain knowledge does not and can not admit

of rigid demonstration, but rests at bottom upon assumptions whose truth must be taken simply upon trust. All scientific proof is really based upon the single hypothesis of the uniformity of nature—a doctrine which can never be demonstratively established, but of which the highest and strongest proof is, and always must be, merely cumulative. The evidence for this hypothesis rests upon our experience, and that is of a limited character. Thus, the foundation of our knowledge is an assumption, which, though highly probable, can not be proved. "And yet we believe: our conviction is so perfect that, even if exact and rigid demonstration were possible, it would add not one particle to the positiveness of our conviction. The fact remains, then, that we believe that which we can not prove. The scientist, no less than the theologian, rests his conclusions ultimately upon faith. When reason halts, faith steps in and leads us onward, and upon the basis of faith our most certain conclusions are founded." Reason, indeed, is our guide; but faith—that faith which, resting upon experience, nevertheless transcends experience—must be the rod and staff on which we lean. The greatest debt we owe to Science, Professor DuBois concludes, "apart from all she has done and is doing for our bodily comfort and our mental development, is for the lesson of faith she is thus ever teaching us—the lesson that Reason and Faith must ever go hand in hand . . . that man can never feel sure of attaining absolute knowledge—that pure truth is not for him; that just so surely as he walks by reason and by reason only, just so surely he must reach a point where reason halts and waits on faith."

Baron Stjerstedt's Antique Coins.—Baron A. W. Stjerstedt, who died in September, 1880, was one of the most distinguished numismatists in Sweden, and in 1857 received the grand prize of the Royal Academy of Archæology of that country for his work on the copper coinage of Sweden and its foreign possessions. He was the author of other numismatic works, and formed extensive collections of Swedish and of antique coins. The latter collection is one of unusual interest and value, not less for its completeness than for the length of time and the extent of territory it represents. Its chronological range is from about 800 B. C. to the reigns of Theodore II of Constantinople, and Manuel Comnenus of Trebizond, in the thirteenth century of the Christian era. Its geographical range comprises nearly all of the world with which the Greeks and Romans were in actual contact. Its historical continuity, although, perhaps, not unbroken, is marred by few extensive or important gaps. The department of Grecian medals includes the municipal, popular, or royal coins of cities, provinces, and states in ancient Lusitania (or Portugal), Spain, Gaul, Italy, Sarmatia, Mœsia, Thrace, Macedonia, Greece, the states of Asia Minor, Syria, Phœnicia, the Parthian kings, Ptolemaic and Roman Egypt, Numidia and Mauritania, nearly a thousand examples in all. In the Roman department are found four pieces described as "autonomous coins of Rome," consular medals, and imperial medals from Julius Cæsar to Julius Nepos, A. D. 475; while in the Byzantine department are placed the coins of the Eastern emperors, from Arcadius to Manuel—making, with a few Gothic and Vandal coins and odd pieces, 2,467 coins of Rome and its Eastern Empire. Ordinary collections are of value as curiosities or for the illustrative specimens they afford. So comprehensive a collection as that of Baron Stjerstedt may be made useful for instruction in numerous ways. It holds the thread of history with a nearly continuous series of object-lessons, and shows the relations of even the most remote points of Europe in very early times. It illustrates the growth and prevalence of myths, the vicissitudes of dynasties, and changes of religion. Some old Roman coins show Romulus and Remus suckled by the wolf. Emblems of the divine legends of the Greeks and Romans abound in hosts of pieces. Some bear contemporary portraits of men with whose names history is full; a group for Judea shows pieces of silver of the kind with which Judas was paid for his treachery; in the series for imperial Rome are shown the growth of Christianity upon paganism, the attempt to supplant it again by pagan rites, and the final triumph of the Christian emblems. In another view, the coins, for the most part still sharp and

bright, illustrate the development and vicissitudes of art, from the rude efforts of archaic and provincial stampers to the finely finished medals of which those bearing the handsome features of Alexander the Great and those of the first Roman emperors may be taken as specimens. The base metal of which the coins of whole epochs were composed attests the antiquity of the dishonesty of "fiat money." The collection, which is offered for sale in this country, will be of great value to the institution that is fortunate enough to secure it.

Vegetation of the Catskill Mountain-Tops.—Professor Charles H. Peck, of the Adirondack Survey, has recorded the fact that many swamp-loving plants grow on the higher mountains of the Adirondacks, where they find the conditions of moisture suited to their growth in the frequent rains, the general prevalence of clouds, and the low temperature, all operating as obstacles to evaporation. He has found on the open summit of Mount Marcy, 5,344 feet above the sea, seven species of swamp-plants, growing five hundred feet above the tree-line, with no protection from the sun except what the vapors afford. Mr. E. P. Bicknell remarks, in his "Monograph on the Summer Birds of the Catskill Mountains" ("Transactions of the Linnæan Society of New York"), that the same fact is observable in that range, and is most strikingly illustrated by the white hellebore, which was noticed in low, damp woods in the valleys and along the streams, and growing in some profusion near the summit of Slide Mountain. "Close around the summit, too, were found, growing in abundance upon the carpeting of wet moss, plants which, at a less altitude, were rare or altogether absent, owing obviously to the scarcity of suitable swampy land. Thus, *Coptis trifolia*, which had not been noticed lower, was abundant; *Viburnum cassinoides*, elsewhere met with only in a small marsh at an elevation of about 1,900 feet, here reappeared, as well as *Viola blanda* (Willd), *Carex intumescens* (Rudge), and other plants less distinctly confined to wet and marshy situations." Mr. Bicknell also observes that in passing from the valleys into the mountains it was interesting to observe of plants of general distribution how much less advanced was their seasonal condition as the elevation increased. The extremes of this contrast, as shown by the vegetation at the summit of Slide Mountain and that of the valleys below, were most striking. Some species, which in the valleys had ceased flowering and were bearing green fruit, were still in full bloom at the mountain-tops; while others, in like condition in the valleys and on lower slopes, on the mountains had not advanced beyond their earliest buds.

Animal Revenge.—The active existence of a feeling like that of revenge and the possession of powers of memory of considerable definiteness and endurance in animals are illustrated in some anecdotes published in a recent number of "Chambers's Journal." Vixen and Viper were two dogs sent to hunt an otter. Only Vixen was able to attack the animal, and she was killed by him. Viper, who mourned for her intensely, went out in the night to hunt the otter; and the two were found on the next day clinched in death, with all the evidences of a desperate struggle around them. A Newfoundland dog was enraged by a traveler who, passing on horseback through the village, struck at him with his whip. A year afterward the traveler was passing through the same village, when the dog recognized him, and bit him through the leg. A friend of the owner of a dog, Tiger, set a stout bull-dog against him, and Tiger got the worst of the fight. He remembered the event, and watched faithfully at the neighbor's door for his opportunity. It came; the dog seized the man, and avenged his wrong. Afterward he tried to make friends with him, and to restore the relations as they had been before the offense was given. A servant-maid was accustomed to throw water upon a dog chained up during the hot weather, and for the best of motives—to cool him off. The dog, however, took the proceeding as an insult, and the first time he found himself loose sprang upon the girl and killed her. It was the duty of two dogs to take their turns at a turnspit. One of them shirked his task, slunk away, and hid. The other, when called upon to take his companion's turn as well as his own, led the people to where the truant was hid and killed him on the spot. A Newfoundland

dog in Cork was annoyed by a cur. He took the animal, threw it over the dock, then plunged in himself and saved its life. Another Newfoundland dog was sent back by its master with a key which was needed at the house. It was attacked on its way by a butcher's dog, but went on about its business, paying no attention to the interruption. The key delivered, it stopped, on its way back to its master, before the butcher's shop, till the dog came out, then attacked it and killed it The story has become an old one of the elephant that cracked a cocoa-nut on the head of a man who had cracked one on its skull, and killed him. Of another elephant—and he was called "the fool,"—it is said that a quartermaster threw a tent-pin at him. A few days later, the animal came upon the quartermaster, lifted him up in his trunk, and put him in a large tree, to get down as best he could. Another elephant was treated to some nuts by a visitor who ended by giving him some so hot that they burned him. In his agony, he drank six pails of water, then threw the pail at the visitor. The two met a year afterward, when the joker offered his nuts again. The elephant ate with relish till the hot nuts appeared, then took the joker by the coat-tails and held him up till the cloth gave way and the man fell to the ground. The elephant proceeded to eat the nuts in the coat-pockets, then tore up the coat-tails and threw the pieces after the owner. The last story is of a monkey, which, being caught stealing a friar's grapes, had to wear a weight on its tail. Afterward, while the friar was performing mass at the church, the monkey climbed to the roof of his cell, and with the weight on its tail broke all the tiles.

Egyptian Funeral-Wreaths restored.—Dr. Schweinfurth writes that he has examined the wreaths which were deposited within the coffin of Aahmes I, King of Egypt, of the eighteenth dynasty, whose mummy is now in the museum at Boolak, and has found them to be composed of the flowers of the *Acacia Nilotica*, the *Nymphæa cerulea* (isolated petals), the *Alcea ficifolia*, and a *Delphinium*, or larkspur, which he supposes to be *orientale*. The wreaths of the other kings, whose mummies were associated with that of Aahmes, contained flowers of *Carthamus tinctoria* and leaves of the *Mimusops kummel*. Leaves of the watermelon were found in one of the coffins. A number of the flowers and leaves have been restored to their shape by moistening them, dipping them in alcohol, and spreading and drying them; and by this means has been obtained an herbarium of thirty-five-hundred-years-old specimens. The color of the chlorophyl, violet in the larkspur, green in the watermelon-leaf, is preserved to a remarkable degree. The Egyptian willow, of the twigs of which the framework of the wreath was composed, the *Acacia Nilotica*, and the *Nymphæa cerulea*, still grow wild in Egypt as well as in tropical Africa. The *Mimusops kummel* has been observed in modern times only in Abyssinia, while the larkspur (*Delphinium orientale*) is diffused all over the East, but is cultivated in Northern Africa as an ornamental plant. The *Carthamus* is still cultivated as a dye-plant in the East and in Egypt. Besides the wonderful preservation of delicate flowers and their colors, this "find" affords new examples of species, both wild and cultivated, which have suffered no variation during a long series of ages. Aahmes I, on whose mummy most of these flowers were found, reigned about 1800 B. C.

Insect Organs of Smell.—Gustav Hauser, of Erlangen, has made the organs of smell of insects the subject of his studies. That they are related to the antennæ is shown quite clearly by several experiments. Glass rods dipped in oil of turpentine or acetic acid, when brought near to insects, caused them to move their antennæ and turn quickly around; but, when the antennæ were cut off, the same insects showed no signs of sensation, although the substances were brought close up to them. Flies with their antennæ cut off paid no attention to putrid meat, although they had previously been strongly attracted by it. Varnishing the antennæ with paraffine was followed by a similar insensibility. Herr Hauser's conclusion is that the organs of smell of most insects consist, first, of a stout nerve proceeding from the brain-ganglion, and running along the antennæ; second, of a perceptive terminal apparatus, represented by

staff-cells proceeding from the hypodermis, with which those nerves are connected; and, third, of a supplementary apparatus, composed of cavities or cones filled with a serous fluid, which may be regarded as out-foldings of the epidermis. The organs appear to be most highly developed, as would naturally be supposed, in those insects which appear to use the sense of smell in seeking for food. The greatest number of smelling cavities and cones are found among wasps and bees, the honey-bee having fourteen or fifteen thousand cavities and about two hundred cones in each antenna, the leaf-wasp a smaller number. The flesh-and-dirt flies have from sixty to a hundred and fifty organs of smell, while the flies that live on plants have only five or six cavities to each feeler.

Photographing the Corona.—Professor Huggins announces that he has succeeded in photographing the solar corona without the assistance of an eclipse. It having been shown by Professor Schuster's observations of the last eclipse that the coronal light as a whole is very strong in the region of the spectrum extending from about G to H, he conceived that by making exclusive use of this part of the spectrum, while enjoying the best possible conditions of exposure and concentration, it might be possible to take a photograph of the kind sought. He found a commercial violet (pot) glass which effected the separation required, and using this—and a potassic permanganate solution in his later experiments—with a reflecting telescope, and gelatine plates, he obtained twenty successful photographs between June and the 28th of September of last year. Captain Abney, whose experiments during the last eclipse have made him a competent judge, declares the photographs as trustworthy as any that were taken then. Professor Huggins believes that there is little doubt that under the most favorable conditions the corona may by his method be successfully photographed from day to day with a definiteness which would allow of the study of the changes which are doubtless always going on in it. By an adjustment of the times of exposure, the inner or the outer corona could be obtained as might be desired.

Cram Examinations.—"Hot-house Education" is the title of a pamphlet recently published in England, on the absurdity of the examinations in vogue there, which are systematically prepared for by cramming. Dr. Crichton Browne is authority for the statement that, by submitting boys of twelve or thirteen to the examinations, "we may be able to select those of the quickest wits, and those most susceptible of cram; but we should certainly not bring to the front those of the greatest grasp of intellect and force of character," and that to institute such examinations at such an age seems to be offering a premium on precocity. In the examinations of older candidates, tests are often exacted of a kind which an examiner who has been quoted by Mr. Froude described as setting a paper "for which Macaulay might possibly get full marks." A case is cited by Mr. Digby, the author of the pamphlet we have referred to, of an examiner who had to appeal to the Geographical Society for the answer to a problem which he had set to candidates, but could not for the time being solve himself. Another instance is that of an examiner for the army who gave out as a subject of composition, "A Visit by Sir Roger de Coverley and the 'Spectator' to Lord's Cricket-Ground." Such cases might, perhaps, be met by fixing the rule that those who make the examinations should be required to pass them.

The Right to Rest.—The London "Spectator" calls for the establishment of a new rule of etiquette, that a man who announces that he is seeking rest shall be let alone. In the hurry and strain of modern intellectual life, a necessity has arisen for periodic rest. "Overwork" is now recognized by physicians as a specific cause of disease, and a few of them are making the effects of over-cerebration, under a hundred names, a distinct specialty. The incomes of several first-class doctors in London are derived almost entirely from men whose brains are overworn, and whose nerves are so "overstrung," or "understrung," or "gone to pieces," or are "so excited," that they can neither sleep, nor work, nor remain quiet. These specialists have become abnormally discerning, and "can tell almost at a glance where anxiety has been the cause of disease,

and where, as sometimes, though seldom, happens, it must be sought in actual overwork; where alcohol or drugs have assisted the decay of nervous force, and where asceticism, tried as a remedy, has seriously injured the resisting power, diminishing the fuel, till every day threatens to empty the store. They differ considerably, we are told, in their practice, some having a lingering faith in the milder narcotics, which others have lost; and some in sleep by itself, which others think is only perfectly recuperative when it comes unsought, . . . but they all agree in recommending perfect 'rest.' Their patients, who have instinct to guide them, and some memories of quick recovery during accidental or incidental lulls in life, always agree with them, but always start the question, how the rest is to be obtained." The distinguished patient can not find it anywhere in the land, for he is pursued wherever he goes by telegrams and letters, and callers, and newspaper gossip; and the only remedy, which some have heroically tried, is to go out to sea, where one can not be followed up; but this is often decidedly inconvenient. So, let the profession, and society, and the newspapers establish the rule that, when a distinguished man seeks rest for a period, he shall not be interrupted in it.

Room enough in the World yet.—Mr. R. Giffen, an English statist, has taken up the Malthusian cry that the world is filling up too fast, and has uttered his apprehension that all inhabitable countries will soon have all the population they can hold—and then what will mankind do? The "Spectator" answers him with arguments very like those which M. Fouillée has used with so much skill and effect in his articles on "Scientific Philanthropy." The laws of increase of population do not work as the Malthusians fear they will, but have ways of their own that it is hard to calculate upon. There is still, and will be for a long time, room enough in the world for all candidates for the privilege of living upon it. The United States still receives and finds homes for all who come—unless they come from China—and has a little room left. The State of New York, with five millions of population, has capacity, according to the standard that prevails in Suffolk, England, for thirty millions. The Dominion of Canada might hold fifty millions in comfort, without neighbors ever visiting each other on foot; and British Columbia has room "for twenty millions of happy people." Then, when North America is filled up, South America offers vast expanses that are not only not occupied, but are in reality not explored, of which Brazil has room for all Europe. Australia could support forty millions in its habitable belt; and Africa—who yet can begin to guess at its capacity? In the mean time, the population of Ireland is diminishing, and the failure of the French to increase excites more apprehension than any fact which is brought to the notice of their economists.

Americanitis.—Sir Charles W. Dilke, in his "Greater Britain," thought he noticed a tendency in the Caucasian native American to acquire the red Indian type of physiognomy. Mr. W. Mattieu Williams echoes this opinion, and has cited several pieces of evidence to show that a change in the direction mentioned is going on, and that it is a process of desiccation produced by the dryness of our climate. Mr. R. A. Proctor asserts that during his three visits to America he lost about thirty pounds in weight, which he recovered on returning home. Mr. Williams's own son, after residing for some time in this country, became thin, lank-jawed, and sallow, "displaying all the characteristic symptoms of what I can not refrain from calling *acute Americanitis*," but began to recover immediately after returning home. On one occasion, at the house of the late George Combe, at Edinburgh, some family portraits were brought out, including those of members who had remained at home, and photographs of members who had emigrated to America a generation before, and with them a portrait of Black Hawk. "We placed the chief on one side, the Edinburgh portraits on the other, and those of the descendants of the American emigrants between, and all agreed that the deviations from the original family type were in a direction toward that of the red Indian. Mr. Combe maintains that this is generally the case, and I agree with him in regarding the typical 'native American'—that

is, the descendant of early English settlers—as displaying physically (I do not say intellectually and morally) a notable degree of reversion—or rather deviation—toward the aboriginal type displayed in the best examples of red Indians—i. e., the old fighting chiefs."

Publication of Astronomical News.—The supervision of the announcement of astronomical discoveries, which has hitherto rested with the Smithsonian Institution, has been transferred by it to the Harvard University Observatory. The first scheme for publishing news of this class in the United States was started by Professor Peters, who arranged with European astronomers for an exchange of reports with the Smithsonian Institution. The orbits of comets were published only in the German "Astronomische Nachrichten" till 1878, when their publication was begun by the Boston Scientific Society, through Mr. S. C. Chandler, in its "Science Observer." Mr. Chandler devised a new and improved code of signals for the transmission of announcements by the Atlantic cable, and engaged the co-operation of the Harvard Observatory in computing the cometary orbits. His publications in the "Science Observer" attracted attention in Europe, so that when the "Centralstelle für Astronomische Telegramme" was formed at Kiel, Prussia, in 1882, Mr. Chandler and his colleagues were made its agents for the distribution of astronomical intelligence in this country. Wishing to provide for their trust a more solid responsibility than their personalities could give it, they offered it to the Harvard Observatory, which accepted it. This act has now been ratified by the Smithsonian Institution.

Influence of Vapor on Radiation.—Professor Tyndall has published an account of some interesting experiments he has made on the variations in the radiation of heat from the earth's surface. On an elevated plateau he hung a thermometer four feet from the ground, and placed another on cotton-wool at the surface. The difference in the registry of the two instruments, that of the surface thermometer being always lowest, varied from four degrees to seventeen degrees, even when no difference was apparent in the clearness of the atmosphere. A careful review of the hygrometric conditions under which the different observations were made established the fact that the variations were dependent upon the existence or withdrawal of the check to radiation which is imposed by the presence of aqueous vapor. As a general conclusion, it may be said that, "with atmospheric conditions sensibly alike, the waste of heat from the earth varies from day to day; a result due to the action of a body which escapes the sense of vision." Similar conclusions, or the basis for forming them, are derived from the observations of Professor Soret, of Geneva, and General Strachey.

NOTES.

The Annisquam Laboratory of the Boston Society of Natural History, which has been in operation for two summers, will be open for the reception of students during the coming summer from July 1st to September 1st. It is situated on an inlet of Ipswich Bay, on the north side of Cape Ann, about three miles and a half by coach from the Eastern Railroad station at Gloucester. It is intended for persons who have already made some progress in the study; and no lectures or stated courses of instruction will be given, but suitable direction and advice. Collecting implements and row-boats are provided, and a yacht will be at hand for dredging parties. Applications may be made to Alpheus Hyatt, curator, Boston.

Professor Edmond Perrier has identified a new crinoid, the *Blastocrinus*, among the animals brought up by the Travailleur from the deep seas off the coast of Morocco. This raises the number of known living species of these most ancient animals of the sea to thirteen. The *Blastocrinus* is marked by a stem of large size supporting a calyx which is composed of five pieces, to which are fixed articulate and very mobile arms. The stem is also composed of a succession of circular articulations, placed one upon another. The radical system of this animal is very interesting. Instead of being concentrated into a single stem, it branches out into a kind of tuft, and the animal seems to have the faculty of putting out a sort of runners, like those of the strawberry.

Professor Frederic Augustus Abel, the eminent English chemist, is to receive from the Queen the honor of knighthood for his services in the War Department in relation to the chemistry of explosives, etc. Professor Lyon Playfair, F. R. S., has also received from her Majesty the honor of Knight Commandership of the Bath.

M. Ed. Landrin has deduced from certain experiments that the "setting" properties of hydraulic cements are due to the presence of an allotropic variety of silica which he calls hydraulic silica. He has prepared this form of silica, and has found that it has the property of forming with lime mixtures that harden under water. At the same time, while primarily it is insoluble in hydrochloric acid, it becomes when mixed with lime susceptible to its influence. He has further discovered that aluminates of lime are at least as soluble in water as gypsum, and are liable to spoil any cement in which they may be present.

Herr Josef Knörlein, the entomologist, died at Linz, February 12th, in the seventy-eighth year of his age.

A company has been formed and chartered to construct and work an electric railway running from Charing Cross to Waterloo, in London. The line will pass under the Thames through iron caissons. The power will be transmitted from a stationary engine to the carriages, and these will run separately, starting as filled, and occupying about three and a half minutes in the trip. A contract has been made with the Siemens Company to supply machinery and rolling-stock, and the construction of the road has been let, to be finished in eighteen months from the beginning.

The death is announced, at Basle, of Dr. Ziegler, the distinguished cartographer. He studied under Carl Ritter, and afterward established in his native town of Winterthur the cartographic establishment now conducted by Messrs. Wurster and Randegger. His most important maps are his great map of Switzerland, maps of Glarus, of St. Gall, and of the Engadine, and a hypsometric map of the world. A geological atlas and an explanatory description of the geological map of Switzerland by him are now in press.

It is estimated that the ivory which was imported into Great Britain during the nine years from 1872 to 1881 (5,286 tons) represented 296,016 pairs of tusks, and consequently a corresponding number of elephants that have been slaughtered. At this rate of destruction the elephant must in no very long time become extinct. Notice is taken in one of the reports of Mr. Webster, our consul at Sheffield, to the Government of the United States, of the small size of a large proportion of the tusks brought to the market, as indicating a wasteful destruction of young elephants. It is time, if this valuable game is to be preserved, to look for some means of checking the reckless hunting of it which is going on.

Herr Johann Spatzier, a botanist of Silesia, has recently died, at the age of seventy-seven years.

Professor P. C. Zeller, the distinguished Prussian entomologist, died suddenly, of heart-disease, on the 27th of March, in the seventy-sixth year of his age. He was the author of a valuable work on *Lepidoptera*, and had made important studies of American forms.

More than twelve months ago, a "perpetual" clock was started at Brussels. An up-draught is obtained in a tube or shaft by exposing it to the sun; this draught turns a fan, which winds up the weight of the clock until it reaches the top, when it actuates a brake that stops the fan, but leaves it free to start again when the weight has gone down a little. This clock was keeping good time in June, after running continuously for nine months.

M. Pasteur's recommendation of vaccination as a safe preventive of anthrax in sheep is contradicted by the professors in the veterinary school at Turin, who aver that, in their own experiments, they have found the vaccinated animals to be as liable as any others to be fatally attacked by the disease on inoculation. M. Pasteur has taken notice of their criticisms, and expresses the opinion that the animals they experimented with did not contract and die of anthrax, but of septicæmia, which is infallibly developed twenty-four hours after death in all animals dying of anthrax. He has offered to subject his views to a practical test, by going to Turin and experimenting with the professors, to show that vaccination, while it may not protect against septicæmia, is proof against real anthrax.

Dr. Bertillon, an eminent French statistician, died on the 3d of March last, having reached the age of sixty-one years. He is credited with having made new applications of the study of statistics, and with having been the founder of demographic science. He was also a naturalist and a close observer of animal structure and life; he paid considerable attention to botany; and has left some valuable labors in mycology. Dr. Bertillon's works in science were performed during the greater part of his life without reward. The chair of Demography in the School of Anthropology, offered him in 1876, was the first public position he held. In 1880 he was appointed by the Prefect of the Seine to the head of the Bureau of Municipal Statistics of Paris, which was founded at that time.

M. Tacchini has succeeded in observing the solar prominences upon the very disk of the sun. By enlarging the opening of his spectroscope, he has been able a few times to recognize on the edges of the spots these grand eruptions of hydrogen and the unknown substance helium.

DR. WILLIAM FARR.